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THE FALLS OF NIAGARA.

BY RICHARD A. PROCTOR.

I WRITE these lines in view of the Falls of Niagara. The very room in which I am writing, though the walls of the house to which it belongs are of more than the usual strength, vibrates like the cabin of an ocean steamer. The roar of the mighty Horseshoe Cataract, combined with the more distant but distinguishable tones of the American Cataract, fills the air with resounding evidence of the might of gravity. *That* is with me the special influence of this stupendous natural phenomenon. It seems to speak to me of the energy of that force which alone, of all the forces known to man, seems to be the constant, ever-present attribute of every particle of matter. When I first saw Niagara from a great distance, the idea of solemn calm, which Dickens found most impressive even when close to the great cataract, forced itself on me as the chief and overruling idea suggested by the contemplation of the imposing spectacle presented here. Even then, however, the sense of constant increasing energy associated itself with the sense of calm and almost of rest. If two ideas so incongruous as rest and work can ever fill the mind simultaneously, it is when, as at Niagara, we see a force at work unceasingly. Restfully, though unrestingly—restfully, because so easily and steadfastly—the great cataract does its work. The consciousness that for thousands of years the same processes have been at work, cutting their way through the strata of the raised land separating Erie from Ontario, the thought that for thousands of years the work will continue, till at last the waters of Erie will find vent in a tremendous cataclysm by which the whole face of the region between Erie and Ontario will be altered, is suggestive of power so immense that its exercise year by year, day by day, minute by minute, seems, when compared with its totality, like rest rather than like work.

But close by the ever-rushing masses of water, especially by the shores of the upper or of the Lower Rapids, one cannot escape the sense of energetic action—at least, I cannot, for my own part. The feeling comes on me that *here* one sees gravity at its work. Here is the mighty terrestrial energy which yet is but a sample on an exceedingly small scale of the energy which operates throughout all space, on suns as on planets, on systems of suns as on solar systems, on systems of such galaxies, and on higher and higher orders of systems absolutely without end. We recognise terrestrial gravity at its work here, however, only because it has here work to do on such a scale as to afford some idea of the real meaning of gravity, and yet within such compass that we can grasp the sense of the work that gravity is doing. And it is because, vast though the work is in one sense, it is so exceedingly minute in another, that the scene presented by Niagara is so impressive when rightly understood. Here gravity works on just so much of the waters of the great lake system between British North America and the United States as corresponds with the rainfall on the area whose drainage reaches Lakes Superior Michigan, Huron, and Erie. The supply is intermittent, the outflow almost uniform. Very slight is the difference which a wet or a dry season makes in the waters of Niagara. But to think that the rainfall of this area, a downfall which seems locally insignificant, is here concentrated into such mighty masses of water! and, still more, to think that the gently-acting forces by which the waters of the sea are raised into the air in the form of cloud, and falling thence as rain (in which a portion of their energy of position is parted with), are here represented by forces acting with such resistless energy, such constant noise and turmoil! To the mere accident (in a sense) that the water raised from the seas has here fallen on upraised regions instead of on the lower levels, to the mere difference of height between the places on which they fall and the sea level from which the sun's heat raised them, we owe the tremendous forces represented by the Falls of Niagara and the Upper and Lower Rapids of this short but most active river. Nay, we may go further, and yet be far within the limits of Niagara's wonders. The clouds which float in the air over North America contain within them potential energies enormously exceeding all the forces at work here in Niagara, for they represent not alone the drainage of the Great Lake Valley, but of the whole area drained by the Missouri, the Mississippi, and the other mighty rivers of the continent. A small portion of these energies, finding its way along the Lake Valley to Niagara, is concentrated into the tremendous exhibition of force which is so impressive—nay, so appalling—to all who stay long enough near Niagara to apprehend rightly its significance.

Here, then, we have Niagara telling us of terrestrial gravity, not only by appealing to our senses of sight and sound in such sort as to overwhelm and confound us by its gathered energies, but also by appealing to our reason so as to assure us that "these are but a portion" of the great force of gravity; "they utter but a whisper of its might, the thunder of its power who can understand?" If, in drawing but a most minute fraction of the earth's rainfall, through a few hundred feet (the Falls themselves are but 160 feet in height) the earth's gravity can present such impressive evidence of its might, what must we think of the whole energy even of terrestrial gravity? And terrestrial gravity is less than the 300th part of Jupiter's gravity, less than the 300,000th part of the sun's gravity, while even the stupendous force of solar gravity is dwarfed almost into nothingness by comparison with the attractive might of Sirius, Vega, Altair, and others of that chief order of stars whose bluish white light tells us of vastly superior mass, and, presumably, of relative youth, from what we know of the laws according to which greater and less masses have longer and shorter stages of cooling—that is, of life. Absolutely as nothing, in turn, is even the

energy of these compared with the inconceivable energy of the whole universe of suns.

We cannot follow step by step these tremendous progressions of force, or even take a single step along the road which leads to this infinity of might. We are appalled in contemplating them, even as one who stands on the verge of a tremendous abyss whose bottom is lost to his view feels giddy at the contemplation of depths into which he cannot advance even by a single step.—*Newcastle Weekly Chronicle.*

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

III.—THE REGULATION OF THE TEMPERATURE OF THE BODY.

As already stated, the skin not only assists in keeping up the temperature of the body when its surroundings are below that which is demanded by warm-blooded animals; but it may, when necessary, also operate in keeping down the bodily temperature when the surrounding heat is excessive. Thus, the skin is a regulator of temperature. In this action, as in others, the skin and the lungs co-operate, and, as we shall presently see, clothing may be made to assist.

Blagden and Sir Joseph Banks exposed themselves to a temperature of 260° in an oven constructed for the drying of statuary, and their bodies, when thus surrounded, only gained two or three degrees above the normal 98°, instead of obeying the law of equilibrium by acquiring 162 additional degrees. M. Chabert, the "Fire King," whose performances at the Argyll Rooms created a great sensation in London, entered an oven heated to above 400°, taking with him a piece of beef, which was cooked while he held it there, showing the wonderful difference between living and dead animal matter. Many supposed him to be an impostor, but this was disproved. He really endured the fiery ordeal, and was enabled to do so by the heat-regulating functions of the skin and lungs, which, in his case, were probably exalted either by training or natural constitution.

I have seen men endure a much higher temperature than this for a short time in the course of "pot setting" in a glass-house. The old crucible, a huge receptacle for eighteen or twenty hundredweight of melted glass, is in a chamber with glowing, red-hot walls, the crucible itself also red-hot. The men chip this out from its setting, to which it is vitrified, remove it, re-make the bed with clay, and then take another bright red crucible from its oven, and erect it firmly on the place of the old one. Any sudden cooling would crack the pot, which is far more sensitive to changes of temperature than the men who handle it.

I am told that at Mackenzie's Enamel Works, Pimlico, the men work daily at a temperature of 300°. Chantrey's workmen were accustomed to enter the drying-oven when the floor was red-hot and the temperature of the air up to 350°.

Examples of this kind might be multiplied, all showing that, in spite of the fact that a rise of ten or twelve degrees of the temperature of the blood would be fatal, the human body may be immersed in an atmosphere having a temperature of one or even two hundred degrees above the fatal limit without itself reaching it. In an ordinary Turkish bath anybody in good health may sit without inconvenience, or even with enjoyment, in a chamber where the thermometer stands at 212°, provided always there is no contact with a conducting substance. I do this frequently.

These facts are usually explained by the evaporation which takes place on the surface of the skin. The millions of sudoriparous ducts pour the secretion of the sweat glands out of the skin-pores, and there the external heat converts the liquid into vapour. In thus converting liquid water into aqueous vapour nearly 1,000° of temperature disappear.

When heat is doing other work it ceases to manifest itself by rise of temperature; thus in expanding the water into 1,700 times its bulk of steam, the heat becomes *latent* as it is called, or more properly speaking, temperature is *converted* into mechanical work; the work of expansion and uplifting the air which by its pressure resists such expansion.

This evaporation of water from the skin plus that from the lungs is accepted by physiologists as a sufficient explanation of the near maintenance of the normal temperature of the body under the circumstances described, but I confess that I am unable to accept its sufficiency. Let me be understood, I do not question its *efficiency*, but do question its *sufficiency*. Its cooling action is unquestionable, and is unquestionably great, but is it great enough to explain the phenomena?

I was first led to question this on reading certain fallacious statements that are repeated in all, or nearly all, the text-books on physiology. Thus Dr. Carpenter says, "The means by which the heat of the body is prevented from rising above its normal standard, even in the midst of a very high temperature of the surrounding air, are of the most simple character. The excreting action of the skin is directly stimulated by the application of warmth to the surface; and the fluid which is poured forth, being immediately vaporised, converts a large quantity of sensible caloric into latent, and thus keeps down the temperature of the skin. By this provision the body may be exposed with impunity to *dry* air of 600° or more, so long as the supply of fluid is maintained. But it cannot long sustain exposure to air saturated with vapour, even though this be not many degrees hotter than the body; because the cooling action of the skin cannot then be carried on."

In support of the same theses, Dr. A. Combe quotes the following from the *Gazette Médicale*, of Paris:—

> A gentleman recently visited the baths of Nero, near Pozzuoli, the ancient Posidianæ. To reach the bath, he had to pass along a narrow winding passage of about 120 yards in length and seven feet high, by about three in breadth. A little within the mouth of the passage the temperature was 104°, in the upper strata of the atmosphere, and 91° near the ground; farther on, the air was filled with dense vapour, of a temperature of 118° above and 111° below; and over the bath it was 122°, the heat of the spring being 185°. After proceeding for about one-third of the length of the passage, he began to feel a sense of oppression and discomfort, his pulse rising from 70 to 90 beats in a minute. A short distance farther the oppression increased, his breathing became rapid and panting, and he was under the necessity of stooping his head frequently to the earth in order to obtain a chestful of air of a less suffocating temperature. His skin at the time was bathed in profuse perspiration, his head throbbing, and his pulse beating 120 in the minute. Continuing his progress, the sensations of suffocation became insupportable; his head felt as though it would burst; his pulse was so rapid as to defy calculation; he was exhausted and nearly unconscious, and it required all his remaining power to enable him to hurry back to the open air. On reaching the mouth of the passage, he staggered and nearly fainted, and was very uncomfortable until relieved by a bleeding at the nose. During the rest of the day his pulse remained at 100; he had uneasy sensations over the surface of the body, and did not recover until after a night's repose. The same gentleman bore a temperature of 176° in dry air without inconvenience.

The first part of this story—viz., the description of the long, narrow, descending, steam-filled passage, and the statement of its temperature, as well as that of the water below, are quite correct, but the latter part concerning the condition of the visitor, is a great exaggeration of the effect on any man in average condition.

I visited this place, and descended by the narrow passage, carrying with me an egg in a little basket. On reaching the steaming subterranean pool, I immersed the egg in the water, and waited until it was cooked rather hard, then returned without suffering any serious inconvenience, and ate the egg. Was drenched by the steam and perspiration combined, and greeted on emerging with roars of laughter by my companions, who had refused to descend, and by the peasants assembled. The guide (purposely) preceded me with a flaming torch, which burned in the vapour with a lurid, sooty flame, and deposited so much of its superfluous carbon on my face that, in wiping it, I painted myself as black as an Ethopian. This wetting, blackening, and a sense of suffocation, due to want of air to breathe rather than the heat, was all the inconvenience I suffered, and no trace of evil remained. My diary shows that I visited all the intensely interesting sights both under and above ground on and about the beautiful bay and promontory of Baiæ, on the same day, walking not less than twenty miles in doing so, and in returning to Naples *viâ* Posilipo.

In the stoke-holes of the passenger ships in the Red Sea, the temperature rises to 145°, and the stokers not only remain there in a vapour-saturated atmosphere, but work very hard.

At Milan I tried a Russian bath, and was shut in a chamber like a sentry-box, into which steam was injected at a considerable pressure. I had no thermometer here, but have no doubt that the heat exceeded that of the passage to the "Stufe di Nerone" above described. The suffocating effect of this atmosphere of vapour was only rendered endurable by holding a sponge to the mouth and breathing through it, but the superficial heat was by no means insupportable.

In all these cases and others that might be specified, the mere superficial evaporation from the skin surface must be but trivial, almost nil, the air around being already super-saturated. In the Russian bath and in descending the steam-filled passage to the stufe, the body, being cooler than the surrounding vapour, was acting as a condenser. The black water with which I washed my face was more largely due to this than to my own perspiration.

How, then, is the temperature of the body kept down in such a super-saturated atmosphere, where death would soon occur if the bodily temperature rose to that of its surroundings, or nearly to it? I will endeavour to answer this in my next.

On page 159 of KNOWLEDGE, Feb. 20, "Hallyards" states a number of facts concerning uncomfortable people who have existed for a while without clothing in temperate and cold climates. He seems to suppose that these cases refute my statements concerning the necessity for clothing. They merely show that the human body has great powers of temporary endurance of evil. The above-stated facts show the same, but do not prove that we could live healthily or long in Chantrey's oven or the vapour-baths of Nero. Dr. Tanner is said to have fasted during forty days, but that does not prove that the rest of us could live on a dietary of nine meals per annum.

An Architects' and Building Trades Exhibition was opened at the Floral Hall, Covent Garden, on Monday. The hall is small for the purpose, but it is well filled with interesting exhibits. A conversazione was given on Monday evening; but it would have been well had this part of the programme been either omitted or considerably modified. It was truly pitiable to see crowds of ladies and gentlemen in evening dress wandering about aimlessly, and shivering with cold, in a room opening directly into the street.

FUTURE ARCTIC WORK.*

By Lieut. Greely.

(*Continued from p.* 150.)

EVER since my attention was first drawn to Arctic work, I have regarded the route *viâ* Franz Josef Land as the true route to the Pole. The voyage and experience of Leigh Smith in 1880, 1881, and 1882, leave no doubt that at some season of every year Franz Josef Land may be reached by a well-fitted steamer. His experiences at Eira Harbour in the winter of 1881-82 show that the explorer can depend to a certain extent on the game of the country as a means of sustenance. Lieut. Payer's sledge trips of 1874 indicate a much greater proportion of smooth ice than has been found in any other route. In thirty days he made a round trip of about three hundred and twenty-five miles, reaching, April 1, 1874, Cape Fledgely, 82° 05′ N. 58° E. From that point he observed "open water of no great extent along the coast bordered by ice, reaching in a north and north-westerly direction to masses of land, whose mean distance from this highest point might be from sixty to seventy miles."

Cape Vienna, the most northerly point seen by Payer, is laid down by him as situated on the 83rd parallel. The extent of land beyond that point is, of course, problematical. The distance from the southern coast of Franz Josef Land to the northernmost point of Nova Zembla is about one hundred and eighty miles. In case of disaster, a retreat by boats is practicable. Weyprecht, in 1874, after the abandonment of the Tegetthof, and Leigh Smith retreating in 1882 in consequence of the loss of the *Eira*, made the journey successfully.

This route, then, presents unusual chances of success with the minimum of danger. It is more than possible that an English expedition will enter these waters. Chief Engineer Melville, U.S.N., has in view an expedition by this route, and his varied Arctic experiences and indefatigable energy mark him as a man peculiarly fitted for this work. It is therefore to be hoped that he will be given the desired opportunity. Two ships, with about sixty men and officers, would be needed. One vessel should winter in Eira Harbour, or some secure point near by, while the second should be pushed as far northward as possible, preferably by Austria and Rawlinson's Sounds; but, if that is not possible, along the west coast of Franz Josef Land beyond Cape Ludlow. The vessels should be provisioned for three years, and the crews should be quartered in temporary houses to be erected on shore. Quarters on land are recommended as being freer from moisture than is possible on ship-board, a fact which, to my mind, has an important bearing on the question of health. A depôt of supplies for use in case of disaster might be established on the northern coast of Nova Zembla. With two vessels, this would not be indispensable, but none the less wise and prudent.

Although not a seaman, I think the following views fairly cover the essential points regarding vessels and navigation. Small, easily-handled steam whalers of good speed should be selected. I have nothing to say as to the best method of strengthening them, but presume those adopted in regard to the vessels of the recent relief expedition leave nothing to be desired in that direction. It is essential that each vessel have a steam whale-boat. It is universally admitted that navigation is impossible through close pack ice. In consequence the utmost care should be taken to avoid besetment. Ross has truly said that patience and caution are indispensable to an Arctic navigator, and to no

* From the *New York Tribune*.

greater advantage can these qualities be exercised than in avoidance of dense pack ice. A ship should maintain almost constant motion, and only moor when absolutely necessary, and then only to an iceberg. Careful observations of the currents, and of the ebb and flow of the tide are of the greatest importance. Marked movements of the ice are most liable to occur after the turn of the tide, and the probable effect of such changes must be foreseen and discounted. It was mainly by increasing watchfulness of winds, currents, and tides, and by sound judgment regarding their effects, that Sir George Nares succeeded in working his vessel from Cape Sabine to the Polar Ocean and back during two unfavourable ice seasons. It was from similar observations that I was enabled, during the retreat of 1883, in a like unfavourable year, and on the same coast, to bring my boats in safety from Discovery Harbour to Cape Hawks.

The expedition should receive its final supplies from Tromsoe, and should not leave that port before the latter part of July. August and September there, as in Smith Sound, are undoubtedly the most favourable months for ice navigation. In case of a bad year for ice the vessels should rather return, to renew the expedition the year following, than adventure the experiences of the Tegetthof. The question whether dogs or men should be employed in hauling is debatable among Arctic men. I unhesitatingly assert that with dogs nearly double the distance can be made that is possible with men. Shelter, fuel, drink, sleeping-gear and extra clothing, which form so large a proportion of constant weight, are not needed for dogs. Lockwood's great northing was made by a combination, the supporting sledges being drawn by men, the advance sledge by dogs. He travelled far enough in ninety days the first spring, after the sun's return, with his single team of seven dogs, to have reached the Pole and return had it been in a straight line. In 1883, depending on dogs alone, he reached the shores of the Polar Ocean in less than half the time taken by men and dogs combined the previous year.

The qualification of the commander of an expedition need not be dwelt on. Much and varied previous service is indispensable; but, in addition, he should be a man who has carefully studied the plans and equipment of all his predecessors in active work. He should not be above five-and forty. Subordinate officers should be under thirty-five, enterprising, fond of field service, and thoroughly dependable—men who will work loyally and faithfully under any and all circumstances and never give mere passive obedience. Officers with varied talents and special training should be selected. One should be a photographer. The men should be as far as practicable of one nationality, of sociable nature, sunny disposition, intelligent, observant, self-reliant, patient, persevering, and moral, and of that class which has seen some hard service. They should be unmarried, and between twenty-five and thirty-five years of age. No man should be taken who has ever been addicted to the use of stimulants. Only in exceptional cases should a man be enlisted who had served in a previous expedition. They should be selected and kept under discipline some time before sailing, in order that those unfit may be weeded out. Some should be good hunters, and as many useful trades be represented as possible. Perfect health is necessary, but especial attention should be given in medical examination to the condition of the eyes, lungs, teeth, circulation of blood, and as to rheumatic tendencies.

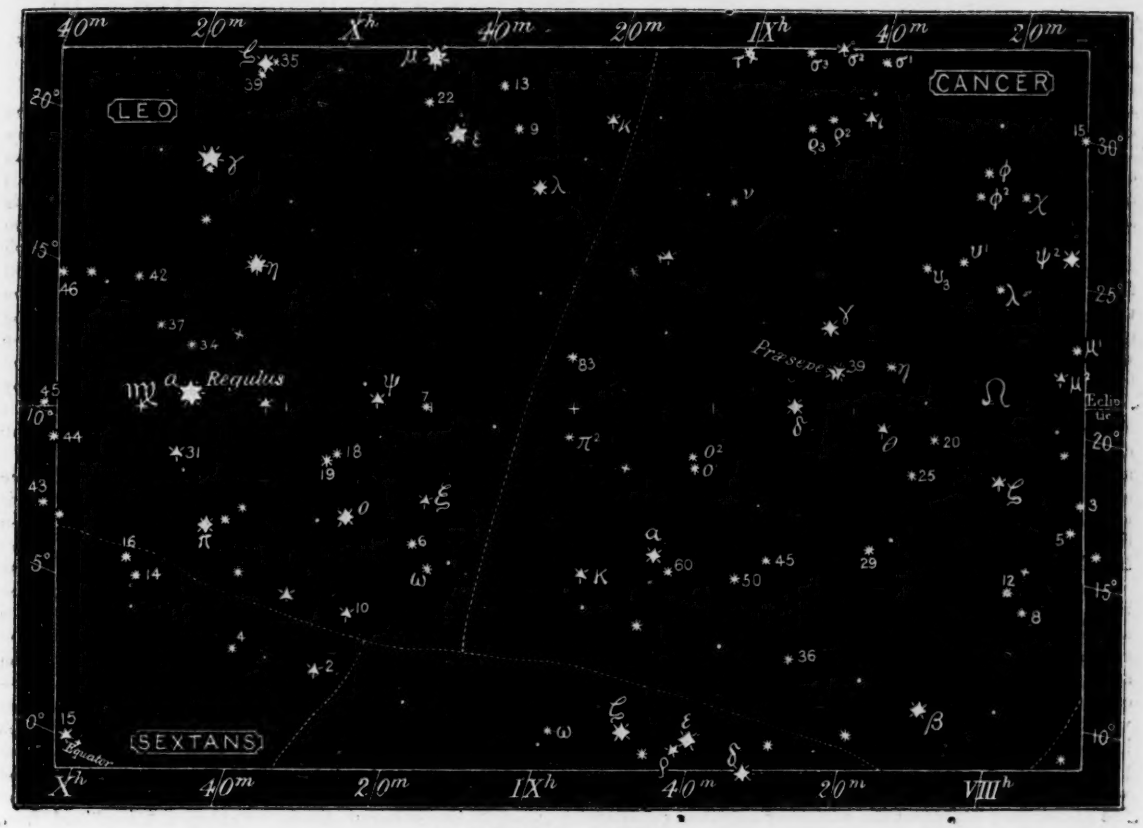
Regarding food, there should be a great variety, and no set programme as to the order in which it is to be issued. Calculations should be made for five pounds per man daily and one and a half pounds per dog. Bacon corned (not salted) beef, ham, and pemmican are the standard meats. Freshly-killed meat should be taken in large quantities in refrigerators. Birds killed by us in July in Greenland were eaten the next June at Fort Conger. Soups, canned and dried fruits, and vegetables of all kinds are especially important. Fresh bread should be had daily. Macaroni, condensed milk, oatmeal, butter, lard, cheese, pickles, preserves, condiments, and tobacco, should be liberally provided. The regular use of high wines should be discountenanced. About one gill weekly per man was consumed by my party, but I should recommend not exceeding half a gill more, or preferably half a pint of *vin ordinaire*. For dogs, dried fish or meat must be provided; they will not eat dog or other biscuits unless nearly starved. While working, meat should always be fed to them. The value and utility of skin clothing has been largely overrated. Thick woollen garments of smooth finish, and heavy flannel underclothing of excellent quality, are enough for all ordinary travel. For unusual exposure, an overcoat slightly lined with dogskin or a heavy woollen *temiak* (a hooded shirt, generally of sealskin) is sufficient. Any well-lined skull-cap, with ear-flaps, will do for head covering. No satisfactory means of protecting the face is known. Woollen with outer sealskin mittens form fitting hand-gear. No single kind of foot-gear is suitable for all conditions. Moccasins and Esquimaux seal boots should be taken in quantities. Leather boots do well in summer only. Heavy woollen stockings, half short and half reaching to the knees, are best for general use. Sleeping socks should be of dog-skin. Well-tanned selected Buffalo robes made into two-men sleeping bags are best.

The Greenland and the Siberian sledges are recommended for dogs. In case hauling is to be done by men, the McClintock and Hudson Bay sledges should be taken. The Melville sledge is excellent for retreat where heavy boats are to be hauled. Sledges are inexpensive, and conditions of travel so vary, that all contingencies should be provided against. Alcohol is the best field fuel. Copper-bottomed, fire-proof cooking-pots, with cylinder in centre, are excellent for sledge trips. There is but little choice regarding tentage, but rubber tent-clothes should be taken

Regarding medicines, iron was most in demand with my party, except lime-juice, daily issued. I doubt governmental aid being extended to Arctic exploration for years to come, but none the less believe in the propriety and certainty of future Arctic work.

The expedition suggested by Lieutenant Ray, United States Army, at the meeting of the British Society for the Advancement of Science, at Montreal, should receive the attention and support of scientific men. The magnetic pole of Boothia Felix Land, located by Ross in 1831, has probably changed its position in the past fifty years. Its relocation would be an important contribution to science. With a home station at Repulse Bay or in Wager River I believe this work could be done without great expense or serious danger. The benefits to be derived from such an expedition would not be confined to terrestrial magnetism. As regards ethnology, botany, and natural history, the country around King William Land is substantially a blank.

As the result of an interesting discussion held at the Anthropological Institute on Feb. 24, incident on the readings of papers by Dr. A. Neubauer and Joseph Jacobs respectively (the former contending that the Jewish race is by no means pure; the latter that it is practically unvitiated), the conclusion arrived at was in favour of the purity of the Jewish race. A most curious fact was stated by Mr. Jacobs, if fact it be, viz., that mixed marriages between Jews and Christians are unfertile.



The Night Sign for February.

ZODIACAL MAPS.

THE Night Sign for February should have been given last month. It originally appeared in our issue for February 1, 1884, but then contained the paths of Mars and Jupiter. We now repeat it, and shall in a fortnight's time repeat the Night Sign for March, in order to complete the series of twenty-four Zodiacal Maps.

FORMS OF LEAVES.

A LECTURE

By Sir John Lubbock, Bart., M.P., D.C.L., LL.D., F.R.S., &c.

(*Continued from p.* 174.)

WE have hitherto been considering mainly deciduous trees. In evergreens the conditions are in many respects different. It is generally said that leaves drop off in the autumn because they die. This, however, is not strictly correct. The fall of the leaf is a vital process, connected with a change in the cellular tissue at the base of the leaf-stalk. If the leaves are killed too soon they do not drop off. Sir John illustrated this by some twigs which he had purposely broken in the summer: below the fracture the leaves had been thrown off; above, they still adhered, and so tightly that they could support a considerable weight. In evergreen trees the conditions are, in many respects, very different. It is generally supposed that the leaves last one complete year. Many of them, however, attain a much greater age; for instance, in the Scotch fir, three or four years; in the spruce and silver, six or seven; in the yew, even longer. It follows from this that they require a tougher and more healthy texture. When we have an early fall of snow, our deciduous trees are often much broken down; glossy leaves have a tendency to throw it off, and thus escape, hence evergreen leaves are very generally smooth and glossy. Again, evergreen leaves often have special protection, either in an astringent or aromatic taste, which renders them more or less inedible; or by thorns and spines. Of this the holly is a familiar illustration, and it was pointed out that in old plants, above the range of browsing quadrupeds, the leaves tend to lose their spines and become unarmed. The hairs on leaves are another form of protection; on herbs the presence of hairs is often associated with that of honey, as they protect the plants from the visits of creeping insects. Hence, perhaps, the tendency of water species to become glabrous, *Polygonum amphibium* being a very interesting case, since it is hairy when growing on land, and smooth when in water. Sir John then dealt with cases in which one species mimics another, and exhibited a striking photograph of a group of stinging-nettles and dead nettles, which were so much alike as to be hardly distinguishable. No one can doubt that the stinging-nettle is protected by its poisonous hairs, and it is equally clear that the innocuous dead nettle must profit by its similarity to its dangerous neighbour. Other similar cases were cited.

He had already suggested one consideration which in certain cases determined the width of leaves, but there were others in which it was due to other causes, one being the attitude of the leaf itself. In many genera with broad and narrow-leaved species—Drosera and Plantago, for instance—the broad leaves formed a horizontal rosette, while the narrow ones were raised upwards. Fleshy leaves were principally found in hot and dry countries, where this peculiarity had the advantage of offering a smaller surface, and therefore exposing the plant less to the loss of water by evaporation.

Sir John then passed to aquatic plants, many of which have two kinds of leaves: one more or less rounded, which floats on the surface, and others cut up into narrow filaments which remain below. The latter thus present a greater extent of surface. In air, however, such leaves would be unable to support even their own weight, much less to resist any force such as that of the wind. In perfectly still air, however, for the same reason, finely-divided leaves may be an advantage, while, in comparatively exposed situations more compact leaves may be more suitable. It was pointed out that finely-cut leaves are common among low herbs, and that some families which among the low and herb-like species have such leaves, in shrubby or ligneous ones have leaves more or less like those of the laurel or beech.

An interesting part of the subject is connected with the light thrown by the leaves of seedlings. Thus, the furze has at first trifoliate leaves, which gradually pass into spines. This shows that the furze is descended from ancestors which had trifoliate leaves, as so many of its congeners have now. Similarly, in some species, which, when mature, have palmate leaves, those of the seedling are heart-shaped. He thought that, perhaps, in all cases the palmate form was derived from the heart-shaped, and that when in any genus we find heart-shaped and lobed leaves, the former may represent the earlier or ancestral condition. He then pointed out that, if there was some definite form told off for each species, then surely a similar rule ought to hold good for each genus. The species of a genus might well differ more from one another than the varieties of any particular species; the generic type might be, so to say, less closely limited; but still there ought to be some type characteristic of the genus. He took, then, one genus—that of *Senecio* (the groundsel).

Now, in addition to Senecios more or less resembling the common groundsel, there were species with leaves like the daisy, bushy species with leaves like the privet and the box, small trees with leaves like the laurel and the poplar, climbing species like the tamus and bryony. In fact, the list is a very long one, and shows that there is no definite type of leaf, but that the form in the various species depends on the condition of the species. From these and other considerations he concluded that the forms of leaves did not depend on any inheritant tendency, but to the structure and organisation, the habits and requirements of the plant. Of course, it might be that the present form had reference to former and not to present conditions. This rendered the problem all the more complex and difficult.

The lecture was illustrated by numerous diagrams and specimens, and Sir John concluded by saying the subject presented a very wide and interesting field of study, for, if he were correct in his contention, every one of the almost infinite forms of leaves must have some cause and explanation.

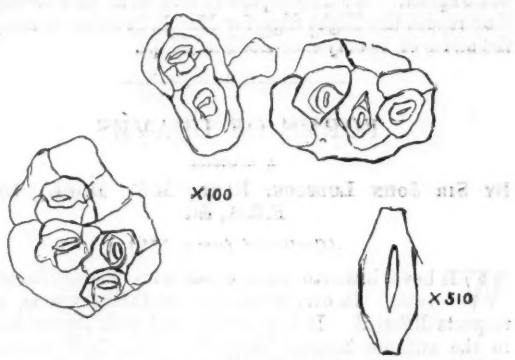
The United States Government has issued a series of 16 maps illustrating Prof. Sargent's report on North American forest-trees.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THE stomata of plants are interesting objects for the microscope, and the leaf cuticles containing them are often finely displayed with polarised light. Stomata, as their name implies, are little mouths, and their function is to facilitate the interchange of gases between the plant-cells and the external air. They are most abundant where respiration and digestion are most actively carried on, which is in green leaves. They are not found in true roots, and are rare in the submerged parts of water-plants. They are not entirely absent from the petals and carpels of flowering plants, and in the castor-oil plant (*Ricinus*) occur in the interior cavity of the ovary. Their number in a square inch varies greatly, as may be seen by comparing the supply in a few common plants. The under side of the leaves is the place to look for them, as in a great many cases there are none on the upper side.

Many greenhouse plants owe the beauty of the underside of their leaves to the arrangement of the stomata. This is the case with some of the Begonias; and if half-a-dozen varieties are examined, a great difference may be seen in the number of the stomata per square inch, and in the patterns they form. In *B. metallica*, so called from the metallic lustre of its rich green-and-red-veined leaves, a hand-magnifier shows a vast number of tiny rosettes containing the stomata. A small piece of the leaf cut from between the veins should be placed on a glass slide—moistened, to make it adhere—with the under-side uppermost, and viewed under the microscope with a half-inch power and dark ground illumination. It will then be seen that the little rosettes contain groups of two, three, or four cells, surrounded by plain cells, as shown in the annexed sketch. Taking a bit of leaf from one of the commoner sorts, with large white bands variegating the green tint, the stomata are found more numerous and thicker together, but not arranged in a definite pattern. A thick, fleshy-leaved species, red underneath, supplies a very pretty object, though not equal to *B. metallica*; but where there is a collection it is worth while to look through them all.



Stomata of Begonia Metallica.

In flowering plants the stomata are generally oval formations, in the midst of which a couple of half-moon-shaped thin membranes approach, but do not quite touch each other with their straight sides. These little membranes or thin cells are most often just below the epidermis, and they leave a slit-like orifice as a little open mouth.

Plant respiration is like that of the animals. Atmo-

spheric air is taken in, brought into contact with fluid matter, oxygen is absorbed, and the carbon of some used-up matter is given off in the gaseous form of carbonic dioxyde (carbonic acid). The green matter of living plants, stimulated by light, treats carbonic dioxide as food, retaining the carbon and dismissing the oxygen. It is to facilitate these processes that the stomata are required, and they vary in size and number in different kinds of plants. Carnations exhibit them on the upper and under surfaces of their leaves. The needle leaves of the fir tribe show them all round; the flat leaves of ordinary trees on the lower surface only. The following figures from the "Micrographic Dictionary" show the numbers per square inch in several cases, and the great range, from 200 to 160,000 is very remarkable.

	Upper Surface.		Under Surface.
Carnation	38,500	...	38,500
Garden Flag	11,572	...	11,572
House Leek	10,710	...	6,000
Tradescontia	2,000	...	2,000
Mistletoe	200	...	200
Holly	0	...	63,600
Lilac	0	...	160,000
Vine	0	...	13,600
Laurestinus	0	...	90,000

When the epidermis and stomata guard-cells are infiltrated with silex, as in equisetaceæ, grasses, &c., the rest of the matter can be removed by boiling in a little nitric acid and dropping in a few crystals of chlorate of potash.* The needle leaves of fir-trees, as shown in a former article, are beautiful polariscope objects prepared in this way.

The stomata are generally largest on succulent leaves and smallest upon hard, leathery kinds. The thick leaves of the Wax Plant (*Hoya carnosa*) show a moderate quantity, with interspaces much larger than in the Begonias. The cuticle may be separated with a sharp pen-knife, and is a pretty object.

The leaves of the hyacinth are good for watching at different stages the growth of the stomata. Sachs says of these organs: "Since the stomata do not arise till rather late, that is, during the expansion of the internodes and leaves, their arrangement is partly dependent on the already elongated form of the epidermis cells: if these are greatly elongated in one direction, and arranged in rows (as in Equisetum, and the stem and leaves of many monocotyledons and pinus), the stomata also appear arranged in longitudinal rows (the cleft lying in the axis of growth, the guard cells right and left); if the epidermis cells are irregular on a superficial view, curved, &c., the portion of the stomata is more undefined and apparently irregular." The same authority gives further details of the development of the stomata, to which the more curious student may be referred.

The figures are magnified 100 linear, except the larger one of a ground cell and its opening, which is magnified 510.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

THE STANLEY SHOW.

In my previous article on the Stanley Show, considerations of time and space prevented me from noticing all the exhibits which I thought worthy of commendation.

During the last two years, no firm has done more than the Surrey Machinist Company to improve the make of tricycles. This firm had previously obtained a great reputation for making very light and fast bicycles. In 1883, I saw a full-sized bicycle of their make which did not weigh more than 18 lb. All the experience they had gained in making such bicycles they utilised in constructing tricycles, making all machines with very light tubular frames, small ball bearings, hollow rims, and laced spokes, and putting the best of work into them. The result has been a great success. Both their single and sociable machines are excellent, while their Invincible Tandem is certainly one of the fastest, and possibly the fastest, tricycle we have. Their exhibit was the best they have yet made, and one of the best in the show.

The St. George's Engineering Company has again improved the make of several of their machines, and reduced their weight. They exhibited a St. George Tandem, a machine with several good points, one being that it can easily be converted by a very simple process into a central-geared front-steerer for a single rider. Their Europa Convertible Sociable is an excellent machine, and their two-speed gearing is one of the simplest and most efficient made. The prices of the St. George's machines are very reasonable.

In my first article on the Stanley Show I referred briefly to Burdess's excellent new front-steering tricycle, with his patent new steering and break, actuated by screw motions, instead of rack motion and lever. Since writing this I have made a further trial of the admirable little two-speed Sterling he made for me last year. The only fault I could find with this machine was that it was not geared high enough for me, being arranged to run at 38 and 52. I have recently had a new crank put into it, with only four inches throw, which answers the same purpose as gearing it up considerably. This has greatly improved the machine in point of speed. I can now ride it as fast as my Humber, and it is freer from vibration than any machine I have. Burdess's machines should now take well, as they are sound in workmanship, and the prices are low.

Nagel's Laced Suspension Saddle, which was mounted on a stand, was tried by many riders, and it seemed to find great favour with them. This saddle has no central portion; the back and front are of leather, and the space between them, about four inches in length, is supplied by a stout leather lace, which can be tightened to suit the taste of the rider.

For the purpose of avoiding any injurious pressure when riding, I should think that Brooke's suspension saddle would be even better than Nagel's, as it is made of two substances of leather, about half an inch apart, and the centre of the upper is removed just where pressure would be prejudicial.

Leni, of Hammersmith, showed a wooden saddle, specially made for the same purpose, and this purpose it seemed to serve; but I understand that he only meant this as a model, and that he is having a saddle of exactly the same form made of thin sheet-steel. When this is covered with leather it will, I should think, prove the safest, most efficient, and most comfortable saddle yet introduced.

Harrington's pivot-mounting for a saddle is very simple and ingenious. It is designed to prevent all chafing in riding. The saddle swivels on a centre, and moves not up and down, but sideways to and fro, with the motion of the legs of the rider. I shall be glad to test this contrivance, which will at least effect a saving in clothing.

Fisher's Transparent Enamel, which was exhibited, I have tried. It is intended to protect bright nickelised work, steel, or gun-metal. It is easily applied cold with a brush, and it appears to answer admirably.

The Cunard tricycles, made by Frank Gibbons, of

* The mode of using the acid and chlorate is explained in Vol. IV., p. 130.

Wolverhampton, were amongst the finest machines shown, both as regards design and workmanship.

In my next I shall refer at some length to the Cunard front-steerer, which I regard as a tricycle of the most advanced type.

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p. 154.*)

WE now come to the second portion of the apparatus necessary to perform the operations of drilling, viz., the drill-stock.

Ex. XXXII. The American drill-stock is one which is very frequently used. To the handle, H (Fig. 11), is fixed

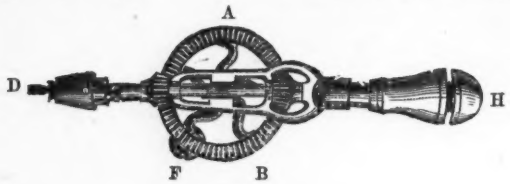


Fig. 11.

a frame, upon the side of which the driving-wheel A B is attached. This wheel gears into one or two (in the form illustrated, two) small pinions rigidly fastened to the drill-spindle, at the free end of which is the drill-chuck. This chuck is generally adjustable, that is to say it is capable of taking drills made from wire of various diameters. A portion of a drill is shown in position at D. Obviously the rotation of the wheel A B by means of the handle F causes the pinion, and with it the drill, to revolve more or less rapidly in one constant direction. It is too apparent that it would be out of all reason for the young worker to attempt the manufacture of a tool of this description. It is, however, very handy, and not expensive. The form illustrated, which is made of malleable iron with steel spindle and chuck, may be obtained from Messrs. Churchill and Co., Cross-street, Finsbury.

Ex. XXXIII. There is another and even a cheaper form of drill-stock, viz., the Archimedian, in which the drill is made to rotate by moving a nut up and down a coarse spiral thread on the drill-spindle. It is not to be recommended, however, to amateurs, as considerable skill is necessary to keep it steady. A want of steadiness naturally involves bending and frequently breaking the drills—rather an annoying experience.

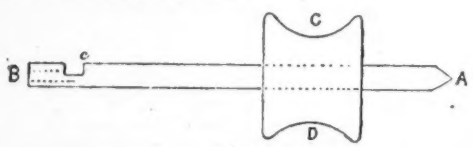


Fig. 12.

Ex. XXXIV. Let us now turn to a form of stock which, while it is very largely employed by practical men in their everyday work, can be made and used by young workers without any great tax either on their ingenuity or their skill. It consists of three parts, the drill stock (Fig. 12), the bow (Fig. 13), and the breast plate (Fig. 14). To use it, the drill is placed in the stock, the pointed end of which, after being slightly oiled, is fitted into the central hole in the breast-plate. The gut of the bow is passed once round the reel. The bow, on being worked to and fro, will cause the drill to revolve and do its work.

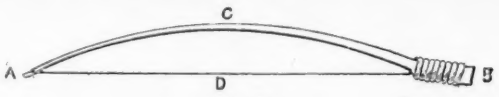


Fig. 13.

To make the drill-stock, procure a piece of bright steel wire, about a quarter of an inch in diameter, and $4\frac{1}{2}$ inches long. At one end, A, make a rather long conical point. When made, the point must be hardened by the method described in Ex. XXX. A hole is now to be bored in the other end (B) of the wire. As, however, we are assuming that our young worker is making his first piece of apparatus for rotating a drill, he is at this particular point unfortunately nonplussed. But the difficulty is not by any means insuperable. Let him take his piece of wire to a metal-worker and have, at a very trifling expense, the necessary hole bored. The diameter of the hole must be the same as that of the wire from which

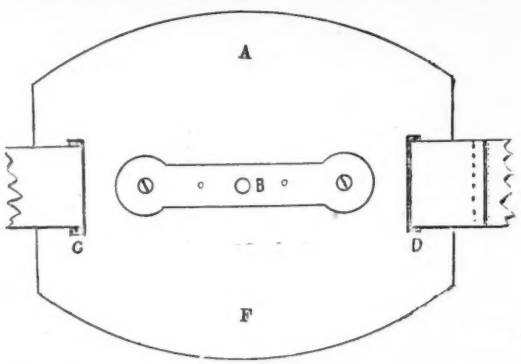


Fig. 14.

the drills are made, and the depth of the hole should be about three-eighths of an inch. The hole being bored, a slot, C, three-sixteenths of an inch wide, must be cut, with the edge of a flat bastard file, in the wire near the end, B. The centre of this slot must coincide with the end or bottom of the longitudinal hole just bored, while the bottom of the slot should be a little below and parallel with the axis of the wire. The object of the slot is to prevent the drill-spindle slipping round the drill (which would, in that case, remain stationary, doing no work). A reference to Fig. 10 (page 153) will help to explain matters. It will be seen that the unhardened end of each drill has a portion of the steel cut away, so that a flat surface is produced at about the axis of the wire. The consequence of this is that when the drill is placed in the hole in the drill-stock, the reduced end passes to the remote end of the slot, while the edges of the flat surface of the drill, coming in contact with the bottom of the slot, compel the drill to rotate with the stock.

Now for the rotation of the drill-stock. Procure a wooden reel, to shape shown (C D) in the figure. The diameter of the reel should be seven-eighths of an inch at the ends and five-eighths at the bottom of the curved groove. The length of the reel should be about three-quarters of an inch, a hole being bored through the centre a trifle smaller than the size of the wire. To fix the reel, drive it gently on to the spindle to about an inch from the end; but this particular distance is not important. The fact

of the hole through the wood being smaller than the wire, enables us to fix the reel with the aid of friction.

The bow is the next thing to be dealt with. Procure a piece of bamboo or cane—preferably the former—about 2 ft. 6 in. long, and $\frac{3}{4}$ in. in diameter. At a distance of 4 in. from the end B of the cane, A C B (Fig. 13), cut with a saw about half-way through the cane; then, with a sharp knife, split it from the end, A, to the bottom of the saw-cut. Then, from the saw-cut, taper off (on the cut side of the cane) to the end A, at which end cut a small groove. About $\frac{1}{4}$ in. from the saw-cut (towards the end B), bore a small hole through the cane.

Obtain a piece of gut, $\frac{1}{16}$ in. thick, and about 4 ft. long (A D B). Tie one end round the groove at A, and pass the other end through the hole bored near B, and wind that portion which is drawn through round the end of the cane forming a handle, the last turn of the gut being fastened by a slip-knot. The length of the gut left between A and the handle must depend upon the length and rigidity of the cane. Two things must be borne in mind. The gut must be sufficiently taut to impart by friction the necessary power to drive the drill-stock. At the same time it must not be so taut as to cause the drill-stock to fly when the drill is released from the work.

The function of the breastplate is to afford a convenient means for supporting the drill-stock during its rotation. It consists of a sheet of metal, A F (Fig. 14), bent on the under side, so as to fit the breast against which it is placed during the process of drilling. Two slots, C D, are cut near the ends of the plate, and through these a piece of tape, gut, string, &c., is fastened to keep the plate in position, or for the purpose of suspension. Upon the front of the plate, between the slots, is screwed or riveted a steel-plate or strap, in the middle of which is bored a conical hole. As the point of the drill stock rotates in this hole, it is essential that the steel strap in the vicinity of the hole should be hardened.

Ex. XXXV. It will be found necessary to give the drill a start. This is done with the aid of a centre punch (Fig. 15), which consists of a piece of steel about a quarter of

Fig. 15.

an inch in diameter and two inches long, pointed at one end. This point, which should be conical, requires hardening and tempering. To use it, simply place the point over the place where the hole is to be bored, and give a slight blow with a hammer. The small puncture thus made becomes the starting-point for the drill.

OUR TWO BRAINS.

By RICHARD A. PROCTOR.

SUGGESTIONS FOR THE PRACTICAL APPLICATION OF THE THEORY.

(*Continued from p.* 142.)

IT would seem, then, that to the left brain we must assign the chief control over speech, writing, and gesture—the methods, that is, of expressing ideas. This side, also, seems principally concerned in the process of reasoning; and besides these special functions, we must assign to the left side of the brain the principal control over the motions and organs of the right side of the body.

The right side of the brain in turn possesses its special functions. It serves chiefly to the emotional manifestations, including those called hysterical, and also to the needs of the body as respects nutrition.* It also, of course, possesses a function corresponding to the control of the left side of the brain over the bodily organs, the right side having principal control over the movements and organs of the left side of the body.

These facts seem to have their practical application.

If the difference which exists between the two sides of the brain depended on a radical difference in their structure, it would, of course, be impossible to bring about any change. The facts I have cited would be interesting, but they would have no practical application, however thoroughly they might be demonstrated. We recognise clearly the difference between the functions of the eye and those of the ear, between the office of the legs and that of the arms; but we do not inquire whether both the eye and the ear might be trained to perform the same duties, nor do we practise walking on our hands, or grasping objects with our feet. But it is manifest that a useful purpose might be served by calling to any person's attention the fact, if such it should be, that he uses one or other eye more frequently than the other, or for different purposes, and that his general powers of sight would be improved if he accustomed both eyes to the same amount and kind of work.† Similarly of the ears. Again some persons are *too* right-handed (I question, indeed, whether one-handedness, whether right or left be chiefly employed, does not in all cases involve a loss of power). In all such cases it is probable that careful training, especially if begun in early life, by tending to equalise the work of each member of each pair of organs, might add considerably to the general powers of the body. It is something of this sort that Brown-Sequard hopes to attain for the brain; in fact, it is

* The evidence adduced by Dr. Brown-Sequard respecting the special function of the right side of the brain is chiefly derived from his medical experience, and would therefore not be altogether suitable to these pages—or rather, its force would not be so clearly recognised as that of the evidence relating to language and gesture. It appears that ulceration of the lungs or liver, hæmorrhage and sudden inflammation, may result more or less directly from irritation, and that in such cases it has chiefly been the right side of the brain which has been affected. Among 121 cases of paralysis, caused by hysteria, 97 were found associated with disease of the right side of the brain, and only 24 with disease of the left side. It is also well known that paralysis is more common on the left side of the body than on the right side, which corresponds to the fact that the right side of the brain is more commonly diseased in the manner which results in paralysis. He cites other medical evidence in support of the theory that the right side of the brain is chiefly concerned in the nutrition of the various organs of the body.

† Perhaps in some instances the reverse may be the case—though we question whether many would care to have one eye specially suited for one kind of work, and the other eye for a different kind. This is not an imaginary case. It is much more common than many suppose, for the two eyes to differ in focal length; and if the difference is not early noticed, it is apt to increase, each eye being used for the work to which it is best suited. I suppose that a marked difference between my own eyes attained its present extent in this way, though the difference was probably considerable in childhood. It is now so great that my left eye is scarcely used at all (and is almost useless for ordinary vision), being very near-sighted, but is almost microscopic for near objects; while the right eye is not used at all on examining minute objects, and very little in reading, but is of average power for distant objects. To use both has become impossible, and may have always been so. I did not notice the difference, however, until I was about 18 years of age. That it existed in boyhood to a marked degree, I consider to be proved by the difficulty I experienced in acquiring skill in such games as cricket, rackets, fives, billiards, &c., where ready and exact judgment of distances is required. I believe that in almost every instance when a boy shows a marked want of skill in such games—while apt in others—it will be found that one eye differs so much in focal length from the other as to be little used. By recognising this early we may be able to correct the defect. Later, correction is generally impossible.

XUM

by this very process that he hopes to bring into action the full powers of this dual organ.

He remarks that "every organ which is put in use for a certain function gets developed, and more apt or ready to perform that function. Indeed, the brain shows this in point of mere size. For the left side of the brain, which is used most, is larger than the right side. The left side of the brain also receives a great deal more blood than the right side, because its action preponderates, and every organ that acts much receives more blood. As regards the influence of action on the brain, there is a fact which hatters know very well. If a person is accustomed for many years of adult life—say from twenty up to forty or more—to go to the same hatter, the hatter will find, after a time, that he has to enlarge the hat of his customer; and, indeed, a person advanced in years, even having passed fifty-six, as I have," said Brown-Sequard, "may have a chance to observe such a change. There is no period of six months that has passed that I have not found my hat, if neglected and put aside, has become too small. The head growing is very strong proof that the brain grows also. Action is a means of increasing size. It is also a means of developing power. I have no doubt that a good many among you have observed that, after paying great attention to a subject, they have not only acquired knowledge on that subject, but become much better able to solve questions relating to that subject—that having developed the part of the brain which has been used for the acts performed, that part has become far better able to perform the duties demanded of it."

The superior size, therefore, of the left side of the brain, as well as the fact that it receives a larger share of blood than the right, show that it is predominant in our system. This fact is also shown by the prevalence of right-handedness among all races of men. There is no left-handed race among all the races that people the world.* But also, the left-handed individuals of every race have the brain correspondingly unequal, only that in their case the right side of the brain is more developed, and that side, instead of the left, controls the faculty of expressing ideas, whether by language or by gesture, and acts chiefly in intellectual operations. The connection between greater development of the brain and the control of reason, and its expression, by the side of the brain so developed, seems conclusively established. The side of the brain which chiefly guides our actions has the greater mass of grey matter, the greater number of convolutions, the most plentiful supply of blood.

Now it appears certain that the greater development of the left side of the brain, and, consequently, if the inferences just drawn are sound, the chief use of that side in reason, language, and gesture, is brought about by actions under the control of will. We exercise most the right side of the body, hence the left side of the brain becomes better developed than the right; and hence, therefore, it assumes the function of controlling intellectual processes and their expression. If, of set purpose, we exercised equally both sides of the body, if in particular we employed the organs on the left side in processes at present chiefly or wholly managed by those on the right, would not the two sides of the brain become equally developed, and might not both become capable of controlling the reasoning faculties? On this point we have evidence which is well worth considering, even if it cannot be regarded as decisive.

Cases have occurred in which the left side of a child's brain has become diseased before the child has learned to talk. In such cases the child has learned to talk as well, or nearly as well, as if the left side of the brain had been sound. Now, if in such cases the child had been born of left-handed parents, we could regard the result as depending on the hereditary transmission of exceptional powers to the right side of the brain. But no such explanation has been available. In most instances, certainly (in all according to Brown-Sequard's belief), the parents of these children were right-handed. In fact, the circumstance that these children, besides being able to speak, could make use of all the members on the right side of the body (though the left side of the brain, which usually controls the movements of those members, was diseased), shows that the right side of the brain had assumed powers not ordinarily belonging to it. The children, however, as might be expected, were left-handed, the left side of the body being governed as the special province of the right brain, and the right side only because the disease of the left brain forced on the right brain the duty of governing the right side of the body, as well as that of controlling reason, speech, and gesture.

(To be continued.)

* Right-sidedness extends even to lower races, though there are few cases in which we have the means of determining it. Birds, and especially parrots, show right-sidedness. Dr. W. Ogle has found that few parrots perch on the left leg. Now parrots have that part at least of the faculty of speech, which depends on the memory of successive sounds, and of the method of reproducing such imitation of them as a parrot's powers permit; and it is remarkable that their left brain receives more blood and is better developed than the right brain. So far Dr. Brown-Sequard on this point. It may be questioned whether monkeys show any tendency to right-handedness; my own recollections of monkey gestures certainly suggest no preference of the kind. Here is a field for observation and inquiry among our zoological professors.

THE FORTHCOMING PHOTOGRAPHIC EXHIBITION.

SCIENTIFIC research of almost every kind owes so much to photography for its successful issue, that any attempt to increase the popularity of the art should meet with ready recognition at the hands of all who are interested in the progress of science. It is no exaggeration to say that some of the most important scientific discoveries could never have been effected without the help of the camera. It has enabled the astronomer to do much towards the solution of the mystery of the heavens; and Professor Draper and Dr. Huggins have already succeeded in determining by its aid some of the elements contained in "other worlds," whose distance from us is so great that it has taken their light, travelling 186,000 miles per second, thousands of years to reach us.

In conjunction with the microscope, too, photography is of incalculable importance in the study of the "ills that flesh is heir to," a notable instance of which may be found in the assistance the camera has afforded to Dr. Koch in his world-renowned bacilli researches; and many of the results pertaining to medical jurisprudence, in the detection of crime, have been largely obtained through the same medium.

Again, photography is of no less importance to the meteorologist, as, by means of a specially-constructed camera, it has been found possible to obtain photographs of the forms and dispositions of clouds, the comparison of which is so necessary in connection with attempted weather prognostication. In a word, almost every branch of scientific study has been, and is likely still further to be, largely indebted to photography; therefore, we say again that any means which can be devised for lifting that art out of professional grooves—where it is necessarily stilted in its operations—should be welcomed by all to

whom the triumphs of science are dear. And for this reason we are pleased to note that an exhibition of photographs by amateurs (the first of its kind) will be one of the attractions of the approaching London season. It is to be held by the London Stereoscopic and Photographic Company, at the Galleries, 103, New Bond-street, W., and will be open from April 23 to May 9 inclusive.

It may fairly be premised that this exhibition will be successful, both inherently and having regard to the further popularisation of photography; for, since the perfection of the "dry-plate" system and the consequent elimination of the objectionable features until then incidental to its processes, the seductive attributes of the art have been made apparent to many thousands of art-loving people of all grades and professions; and the public exhibition of the work of amateurs, together with the competition incited thereby, will not only afford them the opportunity of gratifying a natural pride in their productions, but will also give a decided fillip to the intentions of those who are desirous of enrolling themselves in the ranks of amateur "operators." Another element of success may be looked for in the liberality of the prize-list (amounting in value to over £200), which includes no less than six gold medals and nine silver ones, as well as many other articles of special value.

From the public view-point, too, the exhibition promises to be extremely interesting, as well by reason of the conditions attaching to its formation, as by the diversified character of the exhibits. In this latter connection, it may be mentioned that the late Mr. Cameron, the able special war-correspondent of the *Standard*, who fell at the recent battle of Abu Klea, in the Soudan, had sent home several photographs, which will be included in the exhibition.

It says much for the increasing popularity of photography—and no less for the success of the free-instruction system adopted by the London Stereoscopic and Photographic Company—that this proposed exhibition will be the outcome of the suggestions of their past and present pupils, and the enterprise is one upon which the Company may well be congratulated. We think, however, their representatives have been wise in declining the task of judging the merits of the pictures sent in competition; that duty will be performed by well-known independent judges, including, amongst others, Mr. Thos. Faed, R.A. Amateur photographers will also be represented on "the bench" by Capt. Abney, R.E., who has earned for himself the title of "prince of photographers," and by Mr. John Duncuft, B.A., whose ability to act in a judicial capacity will be well understood by all yachtsmen who practise with the camera. The management and direction of the exhibition has been placed in the hands of Mr. T. C. Hepworth, whose reputation as an authority on photography justifies in every way his appointment to this onerous position, and to whom, at 108–110, Regent-street, W., all communications and inquiries regarding the exhibition should be addressed.

The exhibition is to be divided into thirteen classes, into the details of all of which, however, space will not permit of our entering. Suffice it to say that the competition is open to amateurs generally (subject to certain classifying distinctions), with the exception of Class I. This class is reserved for those competitors who have received their instruction at the studios of the London Stereoscopic and Photographic Company, and embraces "instantaneous" work as one of its special features. Class II. will be devoted entirely to marine subjects, and, doubtless, this section of the exhibition will bear evidence of especial merit, inasmuch as the treatment of such subjects would form an exceedingly attractive accompaniment to the pleasures of a yachting cruise. Class III. is to be styled the "Country House Competition," and will include outdoor groups incidental to lawn-tennis meets, garden parties, picnic gatherings, the hunting-field, and the like. Class IV. is restricted to cyclists, and for this competition one of the prizes, as might be expected, is a steed of high "metal." Class V. is only to be competed for by naval and military officers, who will doubtless make a goodly show, inasmuch as the practice of photography is so useful and in such great favour in the sister services. The remaining eight classes all possess some distinctive feature of interest, and will in combination provide an exhibition which will certainly be unique, and will almost as certainly, we fully believe, be well worth a visit by lovers of photography from all parts of the world.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XVII.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

I.—THE DISPOSAL OF HOUSEHOLD REFUSE.

UNDER this heading may be grouped together: (*a*) dust-bins and garbage receptacles; (*b*) apparatus for the treatment and utilisation of solid and liquid excreta by the "dry" process.

In a former communication* we drew the attention of our readers to the prevailing forms of defective dust-bins, and pointed out the two principal sources of evil which are liable to arise from their use, viz., when the dust-bin is too large, and holds the accumulated refuse of more than a fortnight, the decomposing matters are open to harbour not only the undesirable germs of putrefaction, but also those of disease. It is true that this action is somewhat checked by the cinders and ashes which are also thrown into the dust-box, but they can never act efficiently because of the large size of the particles to be dealt with, and apart from that the process is wasteful in the extreme, inasmuch as it produces a maximum of useless rubbish for the dustman to cart away. The other kind of dust-bin in common use is even still worse than the above; for, in addition, one or two of its sides are formed by the walls of the house, and contaminated damp may thus find its way into the building.

To guard against these defects, a small, movable receptacle, preferably made of galvanised iron, or other non-corrodible material, ought to be invariably used; it is inexpensive and sanitary; and, what is a very important item, labour-saving for the public servants. An excellent form is that which was exhibited at the Health Exhibition Sanitary House, by Messrs. T. H. Pierce & Co., of 62 and 64, Weymouth-street, Portland-place, W.

A unique and valuable variety of the dust-bin has recently come under our notice, and is known as "Dr. Nicholls' Patent Carbon Dust-bin." The principle of this apparatus is a good one; it aims at destroying, or rather checking, the rise of decomposition at the very outset, by the intimate application of charcoal powder, soot, or other deodorant, in such a way that the refuse can be utilised without any trouble and at a very small initial expenditure for the apparatus. Upon the same principle, Dr. R. Nicholls has devised a closet, the working details of which, as of his dust-bin, we shall give in our next communication.

Totally distinct from the above is the apparatus devised to meet the requirements of the "dry-earth" system of the

* KNOWLEDGE, Dec. 19, 1884, p. 506.

XUM

late Rev. Henry Moule, now known as "Moule's Patent Earth System." We have already detailed, at some length,

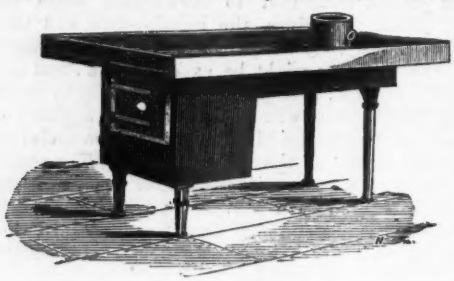


Fig. 4.

the principles and value of that process.* Well dried and sifted earth of a loamy nature ought to be used. It is not always possible to procure sufficiently dry earth in any

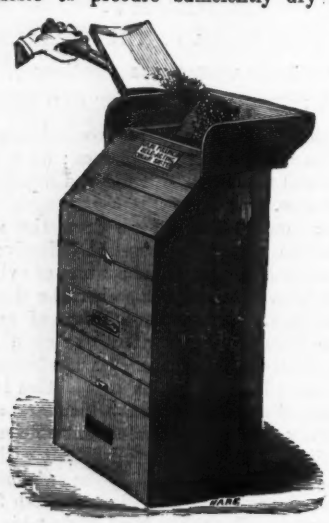


Fig. 5.

quantity, so that the apparatus shown at Fig. 4, and known as a drying stove, may be profitably employed. When the earth has been properly dried, not so dry as to fly into a

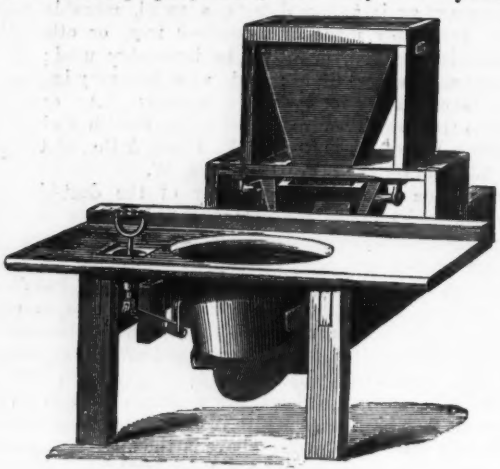


Fig. 6.

* Knowledge, Dec. 26, 1884, p. 523.

dust when it falls, it should be sifted; and in order to carry out that process efficiently, a self-acting sifter (Fig. 5) ought to be used.

The sifted earth must next be transferred to the earth reservoir of the closet apparatus, from which a regulated discharge can be delivered over the soil, either by a "pull-out," a "pull-up," or a self-acting seat action. Fig. 6 shows what we consider to be the best form of Moule's apparatus. Here, when the handle in the seat is raised, after the use of the closet, the soil on the valve beneath the rim of the basin is upset upon the soil; when the handle is returned to its original position a fresh charge of earth is spread thereby upon the valve in readiness for the next user. The value of the valve is obvious; it shields the contents of the soil receptacle from view, and at the same time prevents an upward draught.

Fig. .

Receptacles for the soil are of two kinds. Fig. 7 is a pail of sufficient size to hold twelve charges; it is the most convenient size for carrying up and down stairs and may, or may not be furnished with a cover. Fig. 8 is called a

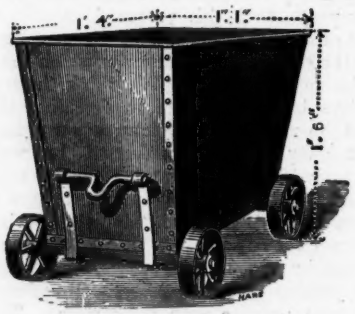


Fig. 8.

"Broadmoor Tank" on wheels, and is best adapted for use in outhouses, or where the manure is destined to collect for a protracted period. We are indebted for these figures to the kindness of Mr. H. J. Girdlestone, of Moule & Co., 5A, Garrick-street, Covent Garden, W.C.

THE INTER-OCEANIC SHIP RAILWAY.*

THE transisthmian projects which for many years have attracted the attention of engineers may be divided, perhaps not improperly, into three classes: 1st. Those in which the construction will be at the mercy of floods. 2nd. Those lacking good harbours. 3rd. Those which empty into the Doldrums, or Zone of Calms. Of these

* Condensed from the *Scientific American*.

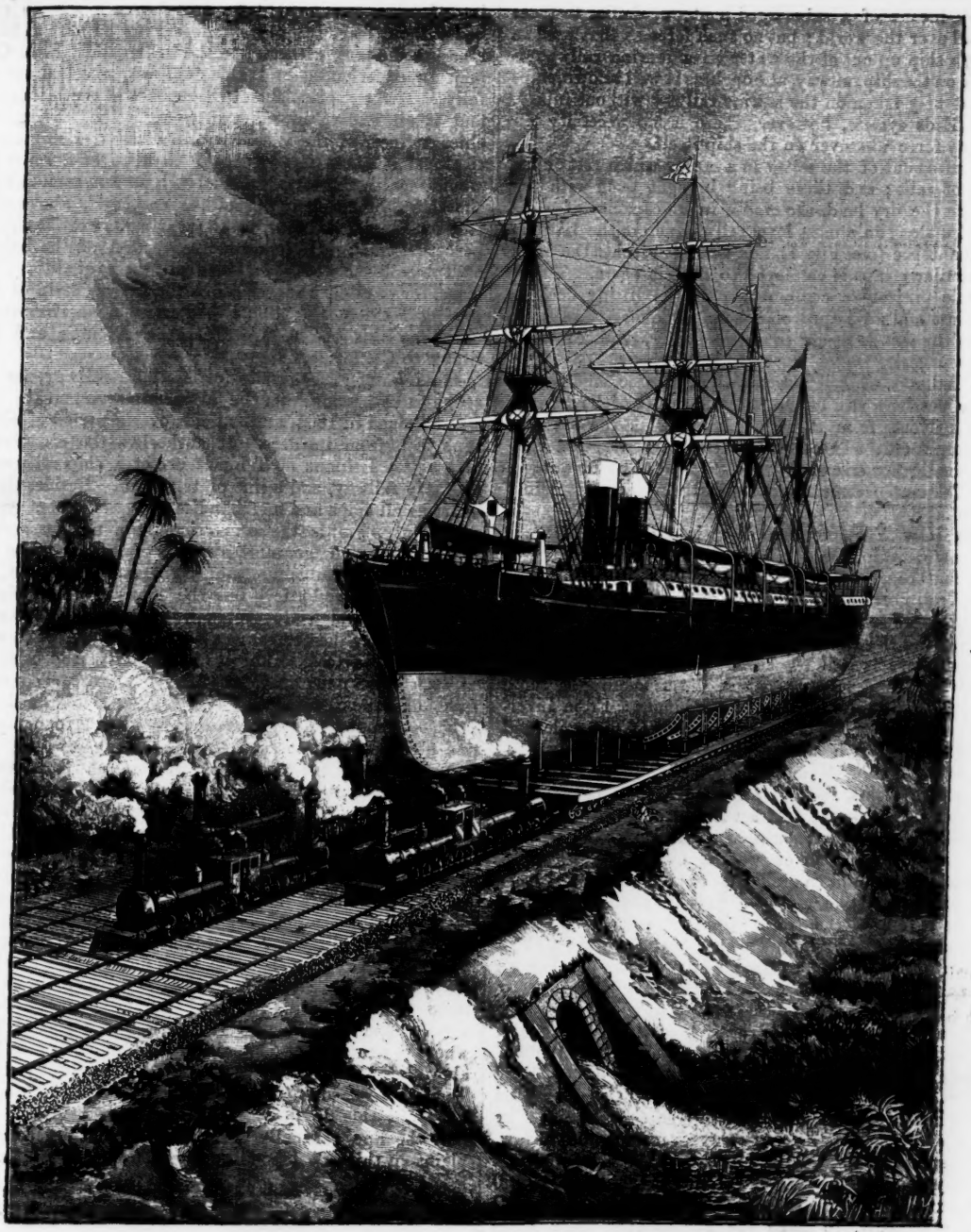


Fig. 1.—A Ship in Transit on the Inter-Oceanic Ship Railway.

three fatal objections, the Panama tide-water canal scheme is open to the first and third, and the Nicaragua lifting-lock plan to the second and third. The ship-railway project of Mr. James B. Eads, now under discussion, is open neither to the one objection nor to the other, and, besides being far less costly, it furnishes a quicker means of isthmian transit than either of them, and will shorten, by considerably over a thousand miles, the contemplated route *viâ* Panama between the Atlantic States and San Francisco or the East Indies.

Until the arrival in the field of Mr. Eads, it seemed to have occurred to no one that anything but a waterway would serve for ship transit between the two oceans. It did not appear impracticable to some of the transmithian projectors to build a ship canal in a region annually inundated by mountain streams, or to expect sailing-vessels to traverse hundreds of miles of wind-bereft seas. But to take ships across a narrow isthmus by rail was monstrous, and not to be thought of.

In the ship-railway project a ship is lifted out of the

water by means of a submerged pontoon, similar to those in use all over the world; but no such force as that used in hauling a ship up out of the water on a marine railway is required on the ship railway, although, as is well known, ships are constantly taken on the marine railway without injury. In the Eads system, however, there is no necessity for using any force whatever on the ship itself.

It is lifted out of the water in a cradle which rests upon a series of rails; and these being brought even with the tracks on the dry land, the cradle in its capacity of a car is wheeled along an almost level railway across the Isthmus of Tehuantepec (see Fig. 1), and when it reaches the other side a similar means is employed to float it again. This is the whole project—a combination of the lifting dock in general use and an improvement upon the marine railway, because the ship is never, as in the latter, required to be off an even keel.

The Isthmus of Tehuantepec is in Mexico, and in the extreme northern end of the long, slim neck of land which separates North from South America, while the Isthmus of Panama is on the extreme south end of Central America, and at the farther end of this strip of land. The advantages of the Tehuantepec route in time and distance are plainly apparent.

From New York to San Francisco *viâ* the Panama Canal, a steamship would be compelled to pass the Isthmus of Tehuantepec, sail south about 1,200 miles, and, after crossing, sail north again the same distance before reaching the short route to San Francisco. From Gulf ports to San Francisco and the East, the difference in distance in favour of Tehuantepec is still more marked; the route between New Orleans and San Francisco, *viâ* Tehuantepec, being about 1,900 miles shorter than *viâ* Panama. From Liverpool to San Francisco there is a saving of 600 miles *viâ* Tehuantepec. With sailing-vessels—and sailing-vessels, much as we hear of steamers, carry fully three-quarters of the world's freights to-day, and are likely to continue to carry slow freights—the contrast is still more marked.

A sailing-vessel, having crossed the Isthmus *viâ* Panama, is left in a very ocean of waters, over which reigns a perennial calm, broken only by occasional squalls and baffling zephyrs. She must be towed hundreds of miles until the region of the trade winds is reached. This, of course, serves to add a large expense to the voyage, and to lengthen it many days, so that when we say the voyage between the Atlantic States and California is shorter by 1,200 miles *viâ* Tehuantepec than it is *viâ* Panama, we greatly underestimate the advantages of the former route. It would be a generous estimate to allow for only ten days'—good authorities say from twenty to thirty days'—delay between the Pacific side of the Panama Canal and the point where a sailing-ship strikes the north-east trades, by reason of calms and the slow progress made while in tow. Allowing that a sailing-ship can average 170 statute miles in a day's run, this would add 1,700 miles to the 1,200 miles extra run required *viâ* Panama, and hence would serve, practically, to make the Tehuantepec route 2,900 miles shorter in the run from New York to San Francisco, and 3 500 miles shorter in the run from New Orleans to San Francisco.

The railway route would serve to shorten by ten thousand miles the present voyage *viâ* Cape Horn from New York to San Francisco, which now is 15,687 miles, and to reduce the distance by water between New Orleans and San Francisco from 16,112 miles to something less than 4,000 miles.

Mr. Eads knew that ships had been going on and off lifting docks without injury from time immemorial, and that vessels that could safely withstand the terrible buffeting of ocean waves could be moved over a smooth road-bed without fear of injury. In order to be sure as to the road-bed, he took with him to the isthmus Mr. E. L. Corthell, an experienced and able engineer, who had successfully carried out his plans at the mouths of the Mississippi, and is an expert in railroad construction, having been chief engineer of the West Shore Railroad. Being a practical man, Eads naturally sought to discover a route that would furnish a substantial road-bed, possess something in the shape of harbours at either end, and, above all, a location outside of that, to the mariner, vexatious belt of perpetual calm. He found a cross-section of the Isthmus of Tehuantepec which combined all these qualities; nay, more, for of all the routes across the narrow strip of land joining Mexico with South America, none shortens so much as this the voyage from the Atlantic and Gulf States to California.

Having selected the site for his ship railway, he now sought a concession from the Mexican Government. This was obtained in 1881, and extends over a period of ninety-nine years from its date. It authorises the construction across the Isthmus of Tehuantepec of a ship railway, an ordinary railway, and a line of telegraph. Besides this, it exempts all ships and merchandise *in transitu* from government duty, grants the concessionaire a million acres of public land, and guarantees protection during the construction and subsequent operation of the works. To crown all, the right is given the company to obtain the aid of any foreign Government, and in consideration of this assistance the company is authorised by the terms of the concession to discriminate in favour of the commerce of such Government against that of all other countries, save, of course, Mexico. The concession obtained, Mr. Eads set about having a careful survey made, topographical and physical.

The length of the whole line will be about 134 miles from Atlantic to Pacific. Beginning on the Atlantic side, the route will start from the Gulf of Mexico, the ships sailing up the Coatzacoalcos River to Minatitlan, a distance of about 25 miles. From Minatitlan there extends for about 35 miles an alluvial plain having an underlying stratum of heavy, tenacious clay. In the elevation and ridges clay loam and sand are found. Next comes an undulating table land, and then irregular mountain spurs of the main Cordilleras, that run through the entire continent, making at this point one of the most marked depressions to be found in its whole length. From this basin the line passes through a valley formed by a small stream to the plains of Tarifa, where is situated the summit of the line. This is 736 ft. above low tide. After traversing these plains, the Pass of Tarifa is reached. This is the most accessible of the many passes in this depression in the mountain chain. From here the line gradually sinks to the Pacific, reaching the plains on this side 118 miles distant from Minatitlan.

(*To be continued.*)

We give the following, for whatever it may be worth, from the *American Druggist*. The accident is, of course, one which may perfectly well have happened:—"A despatch from Knoxville, Tenn., reports the death of a farmer at Somerset, Kentucky, by an aërolite falling on his head from a cloudless sky. The farmer, it is said, was killed instantly, his head having been crushed in. His clothing was torn and burned, and his body was streaked with burning streams of molten iron or detached stones of white heat. His limbs were charred and bent out of all shape. The only other case of human life being destroyed by a meteor is said to have happened in Saxony over one thousand years ago, and other cases are reported. As several millions of meteors are said to enter our atmosphere every day, it is lucky that more of us do not suffer from the bombardment."

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p.* 152.)

THE FIFTH EVENING.

SHEWING THAT THE FIXED STARS ARE SO MANY SUNS, EVERY ONE OF WHICH GIVES LIGHT TO A WORLD.

THE Marchioness was very impatient to know what would become of the fixed stars.

"Are they peopled," says she, "as the planets are? Or are they not inhabited at all? Or, in short, what shall we do with 'em?"

"You may soon guess," said I; "the fixed stars can't be less distant from the earth than fifty millions of leagues*; nay, if you anger an astronomer, he will set 'em farther.† The distance from the sun to the farthest planet is nothing in comparison of the distance from the sun or from the earth to the fixed stars; it is almost beyond arithmetick. You see their light is bright and shining; and did they receive it from the sun, it must needs be very weak after a passage of fifty millions of leagues. Then judge how much it is wasted by reflection, for it comes back again as far to us, so that, forwards and backwards, here are an hundred millions of leagues for it to pass, and it is impossible it should be so clear and strong as the light of a fixed star, which cannot but proceed from itself; so that, in a word, all the fixed stars are luminous bodies in themselves and so many suns."

"I perceive," says the Marchioness, "where you would carry me. You are going to tell me that, if the fixed stars are so many suns, and our sun the center of a vortex that turns round him, why may not every fixed star be the center of a vortex that turns round the fixed star? Our sun enlightens the planets; why may not every fixed star have planets to which they give light?"

"You have said it," I reply'd, "and I shall not contradict you."

"You have made the universe so large," said she, "that I know not where I am, or what will become of me. What, is it all to be divided into vortexes, confusedly one among another? Is every star the center of a vortex as big as ours? Is that vast space which comprehends our sun and planets but an inconsiderable part of the universe? And are there as many such spaces as there are fixed stars? I protest it is dreadful; the very idea of it confounds and overwhelms me."

"Dreadful! madam," said I; "I think it very pleasant. When the heavens were a little blue arch, stuck with stars, methought the universe was too strait and close, I was almost stifled for want of air; but now it is enlarg'd in height and breadth, and a thousand and a thousand vortexes taken in, I begin to breathe with more freedom, and think the universe to be incomparably more magnificent than it was before. Nature has spar'd no cost, even to profuseness; and nothing can be so glorious as to see such a prodigious number of vortexes, whose several centers are possess'd by a particular sun, which makes the very planets turn round it. The inhabitants of a planet of one of these innumerable vortexes behold on all sides these luminous centers of the vortex with which they are encompass'd; but perhaps they do not see the planets, who, receiving but a faint light from their sun, cannot send it beyond their own world."

"You present me with a prospect of so vast a length that no eye can reach to the end of it. I plainly see the inhabitants of the earth, and you have made me discover those that dwell in the moon, and in other planets of our vortex; now these, indeed, I conceive pretty plainly, but do not see so clearly as those of the earth. After these, we come to the inhabitants of the planets which are in the other vortexes, but they are sunk into so great a depth that tho' I do all I can to see them, yet I must confess I can hardly perceive 'em. By the expression you use in speaking of 'em, they seem to be almost annihilated; you ought then to call 'em the inhabitants of one of those innumerable vortexes. We ourselves, for whom the same expression serves, must confess, that we scarce know where we are, in the midst of so many worlds; for my own part, I begin to see the earth so fearfully little, that I believe from henceforward I shall never be concern'd at all for any thing. That we so eagerly desire to make ourselves great, that we are always designing, always troubling and harassing ourselves, is certainly because we are ignorant what these vortexes are: but now I hope my new lights will in part justify my laziness; and when any one reproaches me with my carelessness, I will answer, 'Ah, did you but know what the fixed stars are!' It was not fit, said I, that Alexander should know what they were; for a certain author*, who maintains that the moon is inhabited, very gravely tells us, that Aristotle (from whom no truth could be long conceal'd) must necessarily be of an opinion back'd with so much reason; but yet he never durst acquaint Alexander with the secret, fearing he might run mad with despair, when he knew there was another world which he could not conquer. With much more reason then was this mystery of vortexes and fix'd stars kept secret in Alexander's time: for tho' they had been known in those days, yet a man would have been a great fool to have said any thing of 'em to Alexander; it would have been but an ill way of making his court to that ambitious Prince: for my part, I that know 'em, am not a little troubled to find myself not one jot the wiser for all the knowledge I have of 'em; the most they can do, according to your way of reasoning, is but to cure people of their ambition, and their unquiet restless humour, which are diseases I am not at all troubled with: I confess, I am guilty of so much weakness, as to be in love with what is beautiful; that's my distemper, and I am confident the vortexes can never cure it. What if the other worlds render ours so very little? they cannot spoil fine eyes or a pretty mouth; their value is still the same, in spite of all the worlds that can possibly exist."

"This love," reply'd the Marchioness smiling, "is a strange thing; let the world go how 'twill, 'tis never in danger; there is no system can do it any harm. But tell me freely, is your system true? Pray conceal nothing from me; I will keep your secret very faithfully; it seems to have for its foundation, but a slight probability: which is, that if a fix'd star be in itself a luminous body, like the sun, then by consequence it must, as the sun is, be the center and soul of a world, and have its planets turning round about it. But is there an absolute necessity it must be so?"

"Madam," said I, "since we are in the humour of ming-

* This, of course, is far short of the truth. The nearest star lies at a distance of about seven millions of millions of leagues.—R. P.

† It was Galileo who first adopted this quaint form of speech. He was told that the moon's surface is really perfectly smooth, transparent matter covering the mountains and valleys he described. "If you provoke me to it," he replied, "I will set transparent mountains on that smooth surface, ten times as high as those I have told you of yet."—R. P.

* Huygens.

XUM

ling amorous follies with our most serious discourse, I must tell you, that in love and the mathematicks, people reason much alike. Allow ever so little to a lover, yet presently you must grant him more, nay more and more, which will at last go a great way. In like manner, grant but a mathematician one little principle, he immediately draws a consequence from it, to which you must necessarily assent; and from this consequence another, till he leads you so far (whether you will or no) that you have much ado to believe him. These two sorts of people, lovers and mathematicians, will always take more than you give 'em. You grant, that when two things are like one another in all visible respects, it is possible they may be like one another in those things that are not visible, if you have not some good reason to believe otherwise. Now this way of arguing have I made use of. The moon, says I, is inhabited, because she is like the earth; and the other planets are inhabited, because they are like the moon: I find the fix'd stars to be like our sun, therefore I attribute to them what is proper to him. You are now gone too far to be able to retreat, therefore you must go forward with a good grace."

(To be continued.)

Editorial Gossip.

In the face of the Imperial expenditure to which we are committed, will no disinterested member of Parliament question the Government as to whether any money will this year be asked for, for that wretched sham, the "Committee on Solar Physics?"

Judging from the report of the appeal in the case of Watson *v.* Ellis, on Saturday last, the Lord Chief Justice would seem even to have gone out of his way to encourage the study of astronomy. At all events, he is stated to have exclaimed, "Surely a pedestrian can look up at the stars without being guilty of negligence? If in doing so he is tripped up by something placed on the pavement, which he does not see, where is the negligence?"

Enthusiastic amateurs and students may hence gather that they will be justified in learning the constellations in the most crowded thoroughfares, in sublime disregard of the consequences. Speaking merely for myself, though, if any stellar devotee should walk down St. James's-street with his eyes steadily fixed on Ursæ Majoris, and should happen to run against me, I am a good deal afraid that the impulse to give him a hearty shove would be irresistible.

In pointing out, on p. 133, the evil results which must inevitably accrue from the establishment of a Court of Criminal Appeal, I little thought that such an illustration of the truth of my contention as that afforded by the action of the Home Secretary only last week would so soon occur to justify them. No more wicked, brutal, and indefensible murder than that of poor Miss Keyse by John Lee, at Babbacombe, has been committed for a long time; and yet the vulgar, heartless, and revengeful brute who perpetrated it is (thanks to the Right Honourable Sir William Vernon-Harcourt) still permitted to cumber the earth for an indefinite period. And why? Simply because the drop of the gallows stuck, and three successive attempts to carry out the most righteous verdict of the law failed! Of course, it would have been so very shocking to have finally and effectually throttled this ungrateful monster, who was so studiously careful of the feelings of others. The kind-hearted and benevolent old lady, who tried to rescue him from a career of crime, is, with her poor cloven head and scorched limbs, still and cold in her grave. Don't let us waste any sympathy upon *her*. By all means, let us reserve it for the hardened scoundrel who so awfully mutilated and hacked the life out of her. But let us see where this lands us. A wealthy man, we will say, hereafter commits murder, and is sentenced to be hanged. His friends "get at" the hangman, who, for a "consideration" of £1,000, or even £100, disorganises his ghastly apparatus, and prevents it from acting; and some fussy idiot posts up to the Home Secretary of the day to say that his subordinate has failed to hang the culprit. If that Home Secretary should unfortunately happen to be a Sir William Harcourt, he must, to be consistent, reprieve the gentleman, and add another item of proof to the allegation that Money can do anything, when the ordinary course of Justice is permitted to be interfered or tampered with.

Another and an indefinitely more pleasant occurrence of last week is worth a word of mention here. I refer to the opening of the new premises of the Hampstead Public Library and Literary Institution, which has been in existence more than fifty years; and which numbered Samuel Rogers, Joanna Baillie, Constable, and Linnell among its first shareholders and subscribers. Verily we may exclaim with Borbonius, "*Omnia mutantur, nos et mutamur in illis*," in connection with the popular literature of this period in the lives of the authors of "The Pleasures of Memory" and the "Plays of the Passions," and that of the present day. A morning newspaper then cost sevenpence, to be reduced to fivepence a few years subsequently; and books, magazines (such as they were), and pamphlets were costly in proportion. It was, however, about this date that the Society for the Diffusion of Useful Knowledge and the Messrs. Chambers, of Edinburgh, appeared, almost simultaneously, as the precursors of the army of modern purveyors of cheap and good literature which is now so abundant. The first number of *Chambers's Edinburgh Journal* appeared on Feb. 4, 1832; the first number of *The Penny Magazine* on March 31, in the same year; and the first number of the *Penny Cyclopædia* during the succeeding one. Marvels as these were (justly) then considered, they suffer terribly by comparison with corresponding works in the present day; and I can fancy with what astonishment a frequenter of the Hampstead Reading-room of fifty years ago would look upon the profusion of ably-written and beautifully-illustrated serials of all sorts and sizes which now crowd the tables then so much more sparsely covered.

If it be too much to ask our very numerous correspondents all to write sense, I may, perhaps, plead with them that they might, at all events, take sufficient pains to write legibly. Some of the communications which reach me are penned in a fashion which prompts me to consign them to the waste-paper basket forthwith. In the case of others, if, by long, painful, and deliberate examination, I succeed in deciphering enough to show me that they really do contain something worth printing, I mark them for insertion, and trust to Providence (and the compositor) for the result. Really, though, the caligraphy of many would-be contributors reminds me of that of Horace Greeley; of whom the story is told that, like many other of his countrymen, following numerous and diverse pursuits, he once started as a writing-master. As a "copy" for his class, he wrote on the black-board, "Virtue is its own

reward;" a legend which the only two members of that class who (imagined they) could read it at all transcribed, "Washing with water is absurd!"

IT is not very easy to know what to do to please everybody. Some correspondents get into a furious rage because I refuse to insert communications filling half a quire (more or less) of paper. On p. 134, I did put in a letter which had reached me from a gentleman named Murray; and now *he* is dissatisfied, apparently because I do not hail him as a second Newton; and, in short, regard his "P. D." theory as a Particularly Defective one. However, at the risk of further incurring his ire, I will once more let him speak for himself:—

EDITOR—DEAR SIR,—Thanks *is* not due to the Master for placing my letter of Feb 2nd, in such a conspicuous place, it was not *ment* for publication; no matter now, such like will happen, and show variety, especially if they come under his circumstances of very strong provocation (act.). If infinite variety *constituts* infiniteness, —the master has a good chance of *been* infinitely (wise.) and he has a right to please himself. If "P. D." stands for Pure Delusion it also stands for Ptolemy and Decrescendo. If the ptolemaic's received such a check that brought them to a stand still, it was only because they did not introduce the decrescendo motion, simply, because they *new* nothing about the earth's contraction; according to the law of universal gravitation, our earth must be moving towards the sun, at the rate of 16¼ miles per annum. Her contraction causes her rotating motion to gain 16¼ miles per day, as she revolves round her new orbit,—leaving all her large orbits behind her in one direction; I suppose this sort of bosh, will not account for the, ecliptic circle among the fixed stars, to recede towards the west, at the rate of 50¼″ per annum, or 1° in 72 years,—nor account for, solar time,—nor account for the Julian Calendar, giving our earth one day's more work, every four years to hold the 21st of march in check; or accounts the stars moving a round the pole star;—it accounts for the position our earth holds in the planetary system,—also it accounts for our Master Mr. R. A. Proctor and other astronomers, having to make mean time, which is not worth having (simply) because it deceive's us,—as he tells us that solar time is all bosh as we cannot understand it,—why has the master stated more then once, the earth is supposed to have once been gaseous, and probably as large as the sun in diameter; It has contracted, and is still becoming denser, and consequently of less bulk,—the decrescendo motion tell's us our earth is contracting, at the rate of 5½ miles in diameter per annum, or why was those eleven days dropped in september 1752 which our calendar had gained on true solar time "simply" because they never considered the consumption of our earth, neither one way or the other,—some people forgets that time is only composed by the motion of matter.—Yours

Feb 23. 1885. J. MURRAY.

WHENCE my correspondent obtained what (with a fine sense of Carlyle's "eternal fitness of things") he calls "this sort of bosh," he unfortunately omits to inform us. I do hope that none of the readers of KNOWLEDGE will be rendered uneasy by Mr. Murray's announcement that "our earth is contracting, at the rate of 5½ miles in diameter per annum" (!). Inasmuch as her present diameter is 7,912 miles, it cannot at this rate shrink into a mathematical point until the year 3324, or thereabouts; by which time editor and readers alike will be indifferent to so remarkable a result of "the decrescendo motion."

Reviews.

SOME BOOKS ON OUR TABLE.

Watch and Clockmaking. By DAVID GLASGOW. (London: Cassell & Co. 1885.)—This is one of the series of Manuals of Technology which the Messrs. Cassell are bringing out under the editorship of Professor Ayrton and Dr. Wormell; and, as an attempt to explain the scientific principles underlying the routine work of the practical horologist, is certainly entitled to very considerable praise. Commencing with an account of the solar and sidereal days, and a description of the transit instrument, Mr. Glasgow goes on to describe the primitive methods of measuring time by the aid of sun-dials and clepsydræ, sand-glasses, and candle-clocks, and so down through the rude timekeepers of the 13th century to the famous Westminster Clock. In his succeeding chapter he gives a similar historical sketch of the rise and progress of the watch and chronometer. So far the work is interesting enough to every wearer of a watch or possessor of a clock. The subsequent chapters, though, address the watch and clockmaker more particularly, and amply fulfil the promise held out of explaining the theory alike with the practical mechanical operations of the working clock and watchmaker. To the incipient worker our author certainly imparts a kind and amount of information which would have been wholly unattainable under the old apprenticeship system, and which, if properly assimilated, should bring forth good fruit in raising the British horological workman at least to the level of the very best of his foreign competitors.

Elementary Help-Notes on Latin Parts of Speech and Sentences. By W. THORNTON BULLOCK, M.A. (London: Relfe Brothers).—Mr. Bullock's little book is very well written, but we see nothing in it to distinguish it from divers other primers and elementary Latin grammars that we have from time to time come across.

The Lady: a Journal for Gentlewomen. No. 1. (London: Feb. 19, 1885).—Judging from No. 1, *The Lady* ought to address a very considerable public; everything within its covers being in the best taste. From this, however, we must except the engravings of gowns, in which the artificial reproduction of a repulsive and disgusting deformity now worn by certain foolish women appears in an exaggerated form. A coloured plate of "A New Bonnet," full size, accompanies the magazine, which is otherwise profusely and effectively illustrated.

Elementary Text-Book of Zoology. Special Part. Mollusca to Man, by Dr. C. CLAUS. Translated and edited by ADAM SEDGWICK, M.A., and F. G. HEATHCOTE, B.A. (London: W. Swan Sonnenschein & Co. 1885).—The praise which we accorded (on p. 509 of our last volume) to the first part of this really admirable book may be most ungrudgingly extended to the second volume now lying before us, which completes the work. The same clearness and simplicity of description, combined with rigid scientific accuracy, which characterised Vol. I., is equally apparent in Vol. II., in which the student is led through the mollusca, molluscoidea, and tunicata up to the vertebrata, culminating in the primate man himself. It may suffice to indicate the wealth of illustration in this notable work if we mention that no less than 706 beautifully-executed woodcuts adorn the text of the part now on our table. We shall be greatly surprised if Dr. Claus's elementary zoology, in its English dress, does not speedily become *the* elementary zoological text-book in all schools and colleges where natural science is taught.

We have besides on our table, from the Messrs. Cassell & Co., Part 2 of *Our Own Country* (well sustaining its interest), *The Book of Health* (in which we may direct attention to the article on education as just now peculiarly àpropos), *The Library of English Literature, The Countries of the World, Cassell's Household Guide, Cassell's Popular Gardening,* and *European Butterflies and Moths.* Also, *Society, The Kansas City Review, The Tricyclist, Wheeling, The Medical Press and Circular, Our Monthly* (Rangoon), *American Druggist, The Dyer, Bradstreet's, Parallax,* and the *Book Catalogues* of Messrs. W. Wesley and Charles Hutt.

XUM

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* In this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE PSYCHOLOGY OF INSTINCT.

[1621]—Mr. H. F. Osborne, in his letter [No. 1600], objects to my definition of instinct as being too wide, *i.e.*, it includes excito-motor or reflex actions. I quite agree that in instinctive actions, commonly so-called, there is an element of consciousness; but it is merely the organic feeling of the impression produced on the sensory nerve—that is all. In reflex actions there is no consciousness at all; and this is the only intellectual difference between the two classes of movements. Hartmann, however, opines that in instinct there is "a conscious adaptation to a particular end, without knowledge of what that end is." There may be a conscious collocation of movements, but certainly not a conscious *adaptation* of movements, if the end of those movements be unknown. No one could possibly invent a machine, if the aim or function of that machine be not before the mind; therefore the proper intellectual element (association of ideas or inherited habit) which guides instinctive action is, as it were, unconscious; and, consequently, so far as this element is concerned, the definition of instinct will cover actions purely reflex.

Then, again, your correspondent avers, that "What was once a conscious action may have deteriorated into an instinct, or even into a reflex action." I expressly maintain, on the other hand, that any action which cannot be performed without the guidance of a general notion, can never become instinctive or reflex. It is incontestible that some actions (such as walking, &c.), having their origin in a slow and painful education, ultimately become instinctive—*i.e.*, the various movements which compose these actions are, after a time, collocated unconsciously. It must be particularly observed, however, that these actions are organic or belong to animal life; they are guided by concrete (not by general) notions, and they are not concerned in the production of effects altogether outside or independently of the animal itself and its functions. The wondrous architectural talents of bees, ants, and birds originated, I believe, in the dictation of individual experience. Actions guided by general ideas are incapable of organic transmission to posterity.

P. Q. Kegan.

[1622]—Your correspondent, "A. F. Osborne," in his letter (1597), counsels progression backwards. "Such inquiries as these into the union of mind and body belong to the realm of metaphysics, not that of physics." He does not seem to have grasped the facts (1) that metaphysics has for centuries tried its hand at solving such inquiries, and has failed; and (2) that all the brilliant discoveries as to the true physiology of mind as a brain function have been made during a comparatively recent period, and have been reached by purely physical methods of research—in fact, by regarding mental phenomena as physical phenomena, using physical, in its largest sense, as natural (φύσις). As well abandon modern astronomy for astrology, chemistry for alchemy, as go back to metaphysics for information on what is really a physical problem.

"From a scientific point of view, we must always remain in absolute ignorance as to the true nature of the soul." A truism equally correct when applied to electricity. We call it a "fluid," but, from a scientific point of view, we must always remain in absolute ignorance as to its true nature. We do not on that account, however, relegate the study of its phenomena to the realm of metaphysics.

A small hæmorrhage disorganises, a splinter of bone causes pressure on a limited portion of brain substance. Mark the results:—(1) Muscular movement and sensation are paralysed over a definite area of the body; arm or leg, or both, are motionless and devoid of feeling—practically dead. (2) Consciousness is abolished for the time being, thought is impossible, emotion unfelt, volition extinct. All evidence of a living soul is absent; it is practically dead, as much as the physical properties of motility and sensation. Now the cause of the two conditions is precisely the same. Will it be maintained with respect to one and the self-same injury that inquiry as to its mode of causation of paralysis of motion and sensation belongs to the realms of physics, but that inquiry as to its mode of causation of paralysis of thought and consciousness belongs to that of metaphysics? Yet this is the logical proceeding to which Mr. Osborne's argument would commit us.

The connection of mind and body is eminently a physical question, at any rate from the *body* side. Any knowledge we posses worth having on this subject is the fruit of modern scientific psychology and biology in general. To go back to metaphysics for further enlightenment would be an endeavour to explain *ignotum per ignotius*, and to exchange broad daylight for a veritable will-o'-the-wisp.

Science regards the whole of Nature as an "open secret." To aid in exploring its arcana and unravelling its intricacies all her sons are invited. The intervention of priest or high priest is superfluous. No *sanctum sanctorum* is acknowledged, with entrance granted only to a favoured few. All workers are welcome, and none who honestly labour are sent empty away. Ganglion.

OMNIPOTENCE AND FREE-WILL.

[1623]—Letter 1593, in your issue of Feb. 20, is a gem of reasoning too brilliant to be passed by unheeded.

The argument of the writer there is that, given an almighty will, it is possible for such a will "to will that there shall be beings who shall have a will of their own." This is a truism which none will dispute. What "F. W. H." and all reasoning men do dispute is that it is possible for an almighty will to *co-exist* with a distinct free-will.

Given an almighty will, then no act—not even self-destruction—is impossible to it; but if, in the exercise of its power, it destroys itself, it is then not only not almighty, but not at all. Similarly, if it limits itself "by the creation of beings gifted with a power of free-will," from the moment of such creation its almightiness ceases to exist.

It is pitiful to know that William Fitzgerald is a representative of a large class of men who hold on to such straws as this, without apparently a doubt as to their stability; and, quite content that by such sophistry they are able to reconcile their reason with their adopted theory of human life, are constantly to be heard, when expounding this theory, using terms mutually contradictory in a fashion which makes a hearer wonder however their brains are convoluted. Trebor Rolyat.

[1624]—I am sorry I should be called upon to show the truth of a "truism" which to me seems so obvious. If I grant the existence of an "all"-mighty will, that implies to me a will which controls, directs, has power over "all" other wills. Equally a "free" will implies to me a will which is "free entirely," *i.e.*, not controlled, directed, influenced by any other will or power, but its own inherent one. If Mr. Fitzgerald can think or imagine two such wills existing side by side, he can do what seems to me impossible. I cannot even think of "all-mightiness" doing impossibilities, since if impossibilities can be done, they cease to be impossibilities.

In reply to "Eyewitness," letter 1595. I certainly expect anybody who tells me that his body and his soul are not one and indivisible, but two distinct entities, and that soul, thought, consciousness, are not functions of his living, normal brain, but an entity distinct from it, to tell me what becomes of this entity when the brain ceases its work or ceases to live, and where this entity was before his brain came to perfection or birth, and would also like him to tell me how an "immortal" thing can have birth or origin? If Mr. Alexander wished to make a comparison, not a small joke, he might have said, where is the "light" when it is blown out? To which I reply, exactly where his soul will be when consciousness or life is gone out. F. W. H.

[This discussion, drifting nearer and nearer to the confines of a purely theological one, must now cease.—Ed.]

MIND AND BRAIN.

[1625]—In the four months which have elapsed since the publication of Mr. Jones's first letter upon this subject (1414), he seems to have forgotten what his original contention was. Stated briefly

his theory was that great mental power rises "from the harmony which exists between the several parts of the brain rather than from the size and weight of the brain. Let 7 represent the maximum development of any of the parts of the brain. Would not a man, all the parts of whose brain marked 5, produce greater effect, be a greater genius, in fact, than the man whose brain had 3 parts each equal to 7, but all the rest varying from 1 to 4?"

Now, however, he allows that it is possible that "the man whose brain had 3 parts each equal to 7" would be a greater genius than the other; but, he adds, those 3 parts must be in harmony. Of course. But I did not for a single moment maintain the contrary. If the part denoting foolhardiness is equal to that denoting caution, the two will counteract, and the result will be *nil*. And this, it seems to me, is an insuperable obstable to Mr. Jones's theory as first stated; for if all the parts of the brain mark 5, the opposite faculties of the mind will all counteract one another, and the result will be *nil*. Will a man who is endowed with such a mind as this be a great genius? I trow not.

To turn now to the main point. If the size of the brain and the complexity of its parts has nothing to do with great mental power, how comes it that "the human brain greatly exceeds the animal brain; and the most advanced races of men have the largest brains; and that "men distinguished for mental forces have, as a general rule, brains of an unusual size?" (Bain).

Or how comes it that, in the natural order of the primates, "the series of brains show a remarkable rise or development," the lemur having a small and comparatively smooth brain, while the brain of the chimpanzee or orang-utan is far larger and more intricate? And if we compare the brain of a man with that of one of the higher apes, we find that the former far exceeds the latter in quantity, and it is also "seen that in the ape-brain the lobes or hemispheres have fewer and simpler windings than the more complex convolutions of the human brain."

These facts, it seems to me, tend to prove that the size and complexity of a man's brain have a great deal to do with his mental power. When Mr. Jones can bring forward any similar facts which support his theory, he may expect us to believe in it; but, until that time arrives, our belief in the superiority of man's mind to that of womankind will not be shaken. A. F. OSBORNE.

THOUGHT AND LANGUAGE.

[1626]—After posting my letter (1589), it occurred to me as being (in the latter part) so deficient in courtesy, that I fervently hoped the Editor would expunge *that*, if he did not burke the whole. I am glad Miss Ballin's rejoinder (1604) has given me an opportunity of expressing my regret. Even towards men that sort of writing is objectionable.

As to the question of *fact*, I do not see the rejoinder corrects me. Her contention is that man managed to make head against the beasts by dint of language, association, and weapons; I say that is entirely wrong, because much feebler animals have survived without any such aids.

It was an army surgeon of large experience who made the statement that severe wounds often heal in open air, but kill in hospital. I am sorry I have forgotten the reference.

I never said "primitive man may have been muscled like a lion, *because* David," &c. *Contra*, I meant, If David, *not* a primitive, &c., *à fortiori*, &c.

As to clothes, all nurses know that children's legs and arms begin to "pine" and dwindle as soon as they are covered, even in our inclement climate. *Ergo*, clotheless man *must have been* (*cæteris paribus*) stronger than clothed man. One obvious reason of this is that clothes prevent the poisonous exhalations of the skin from being dissipated in the air. The Arabs never bandage a wound; they say the air is needed (despite its "germs") to effect healing. If you shut up half of a lot of meat soup in a vessel, and leave the other half open, you will find the covered half sour and spoilt long before the other. Also, the more bare skin the more breathing power, which is life.

My object not being victory or controversy (still less abuse), but truth, I ask again leave to protest against the conclusion of Miss Ballin's second article, "Man's mind was developed by the struggle for existence." *Ex hyp. evolut.* All other races are older than man. *No* other races have developed mentally like man, though *all* have been struggling (and successfully) for existence longer than he has. *Ergo*, man's mental superiority is *not* the result of these circumstances, but is itself the efficient cause of his use of firearms, language, and of his domination over all other animals.

Miss Ballin calls me "your anonymous correspondent," as if there were something mean or suspicious in a pseudonym. Even in these days of signed articles, I think that all who are not absolute authorities on this subject show most modesty by keeping their names dark. HALLYARDS.

THE NEED OF CLOTHES.

[1627]—I have read with interest the letter of "Hallyards," No. 1608, and I agree with his conclusions. I lived seven years in Colorado, and have herded sheep in weather so cold that the food I took out for lunch froze hard in my pockets—thermometer sometimes 15° or 20° below zero—and I used to wear less clothing than I now do here, although naturally sensitive to cold, owing to weak circulation. I well remember a half-witted man, Marvin by name (who has since then committed a dreadful crime), who used to get a precarious living by hunting in the mountains, and who, in the coldest winter weather, went about in rags—practically unclothed. Another "old-timer," who was a teamster, invariably went about in the severest weather and most biting winds, with his coat open and his chest perfectly naked and exposed. Surely the London street-Arabs, who are at once half-starved and half-naked, prove that the power to resist cold is merely a matter of habit, and that we might make ourselves "all face" if we liked, though doubtless a modicum of clothing is comfortable, if of doubtful sanitary value. I firmly believe that overcoats are the most fruitful cause of winter colds, and that the best and safest plan is to make little or no difference between summer and winter clothing. J. W. BOOTHROYD.

TERMITES.

[1628]—I have read Dr. Hutchinson's article on Termites, p. 142, with great interest, but one sentence is so puzzling that I feel sure many readers of KNOWLEDGE would like a little further explanation. He says: "But, then, what is the use of the wings?" "What, then, the necessity of the swarm? I believe it to be a provision of nature for lessening the species by bringing it into contact with the host of devourers ready to hasten to the feast either by day or night." This appears to me quite opposed to the theory of evolution, for surely those individuals which first took to flight would have but little chance of handing down such a peculiarity to future generations, without reaping some corresponding advantage.

But if we fall back on direct creation, the difficulty is not lessened. Would an intelligent Creator adopt such a clumsy and roundabout means of keeping down the number of individuals of the species, when the object could be attained by creating them less prolific to the required extent, or by other simple means? I should like to know what Mr. Grant Allen has to say on the subject.

GEORGE HANN.

LETTERS RECEIVED AND SHORT ANSWERS.

THOMAS AYERS. What is solar heat itself but a form or mode of motion? This being so, if I rub a brass button upon a wooden plank until it becomes so hot that it will ignite phosphorus, in what sense can such heat be held to have its origin in "processes of chemical change?"—E. A. TINDALL. I must differ from you, *toto cælo*, as to the origin of ideas of the spiritual or immaterial in nature being "entirely devoid of any *scientific* .... explanation or interest;" inasmuch as the investigation of the inception of such ideas in the mind of primitive man is replete with interest of the most absorbing character to the psychologist and anthropologist. With reference to your really interesting account of the measurement of a myopic pupil by Mr. Gorham's photometer, and the discovery that its diameter was less than ·05 inch, I can scarcely accept your hypothesis that short-sight is due to an inability of the ciliary muscles to dilate or contract the opening of the pupil. And for this reason, that all short-sighted people will tell you that when their pupils are caused to contract by a strong light, their sight is quite notably lengthened. At any rate this disposes of the idea that the subject of Mr. Gorham's experiment was myopic because of the small diameter of his pupil.—T. COMMON. You are mistaken. Romford and Davy both disproved the possibility of the existence of caloric. So again with your idea that the corpuscular theory of light is not susceptible of disproof. Undulations may and do, as we know, extinguish each other, material particles never. Did you ever hear of the phenomena of interference? But *the* crucial test of the validity of the corpuscular hypothesis, under which it broke down, is this. Were it true, light must travel faster through a refracting medium than through empty space; while, on the other hand, if light consists of undulations or vibrations, it must be retarded by refraction, which, as a matter of experimental fact, it is found to be.—COMMENTATOR. Your fallacy lies in regarding the desert region of South-West Australia and that of the interior of Zanguebar as in any sense "primeval." Why, great and notable alterations of level, and successions of fauna and flora may well have occurred in both localities within a period quite (geologically)

recent. Had you not better send your two cases of "calling" direct to Mr. Gurney? *Re* (so-called) "Spiritual" literature, you seem to proceed upon the simple principle, "*Credo quia impossibile est*," to have read the rubbish of those who have failed to find out how the "mediums" do (often clumsily enough) their tricks, but to have studied little or nothing written by the very few scientific men who have condescended to notice the subject. Really, the cleverest of the slate-writing fellows is a fool by the side of M. Verbeck, now performing at the Princes' Hall in London. M. Verbeck, though, is honest, and says that his marvels are effected by sleight-of-hand. The "mediums" are scandalous impostors, who trade upon the ignorance of their fatuous dupes by pretending to be in communication with the other world. I could fill a quarter of this column with the names of these people, who have been successively detected in their sorry cheating; but it is really degrading the pages of KNOWLEDGE to admit any reference to "spiritualism" into them at all.—CHAS. ROSE. I cannot suffer the question to drift into pure theology.—W. H. BANSALL, B.A. Miss Ballin, as you will see, has had an opportunity of very promptly expressing her own opinion of the letter of "Hallyards," who, moreover, as you will see from his letter [1626] on p. 203, has himself promptly expressed his regret at the tone in which he criticised her theory. When our contributors themselves complain of the criticism of their utterances by their readers, it will be quite time enough for me to take action in the matter.—H. A. B. The empirical law to which you refer can only possibly apply to a partially-illuminated body seen through a great thickness of atmosphere. Why, at the distance you name, the man's height would subtend an angle of more than 68″; while that of the motes in the air, rendered visible by Tyndall's Electric beam, is utterly insensible and immeasurable. What angle do you suppose that a floating gossamer-thread subtends at your eye, when the brilliant illumination of the sun renders it visible? The angular diameter of Mars varies between 4″ and 30″; that of the ball of Saturn, alone, between 15″ and 20″; his astonishing ring-system much more than doubling this.—AN EARNEST THINKER points out that there are two misprints in letter 1606 (p. 159) both in the second line: "single" should be "simple," and "of it" appears for "ft."—DR. LEWINS also complains that on line 25 of the second column of his letter (1602), on p. 158, the comma should be after "such," and not after "self," as printed.—L. H. SPROTT. I am very sorry that you have got a non-achromatic telescope. With an achromatic of the same aperture you would see enormously more. In reply to your questions, you can see 10th mag. stars with your telescope; 6th mag. only with the naked eye. You will perceive Mercury most indifferently. The crescent of Venus you *might* see towards the end of this year, but that she will be so very badly placed. The moon you will be able to see a little of when she is about half-full, of Mars nothing. Jupiter as a most indifferent little disc, bordered with orange light; but you will pick up his four moons easily enough; Saturn's rings certainly not. The magnifying power of your eyepiece is 30, but its component lenses ought only to be 1½ inch apart. The telescope is not worth any higher power.—E. GOULD (Bury St. Edmunds). Will you be good enough to read the italicised paragraph which appeared on page 473, and elsewhere in the last volume of KNOWLEDGE?—S. S. GREATHEED, M.A. "When the sun was a nebula, extending to the orbit of Venus," I wonder what the condition of the earth was. Suppose that it was itself a diffused nebulous mass, equally illuminated throughout!—H. CAMERON GILLIES. Many thanks, but such a subject would hardly fall within our prescribed limits. At the same time, I am greatly in sympathy with you, regarding, as I do, that subject as on about a par with meteorology as a *science*.—F. W. REYNOLDS proposes to fit a mercurial compensated pendulum, making eighty-one beats per second, to an Austrian clock. The steel rod, which is about ·156 in. in diameter, weighs 2 oz., and the mercury cistern itself is of such diameter that, when filled 4 in. deep, it holds 1 lb. of mercury. The clock train is not strong enough to drive a heavier pendulum than this. Can any practical horological correspondent tell him whether a depth of 4 in. of quicksilver in such a pendulum as this (which obviously should be about 21½ in. long from the centre of suspension to the centre of oscillation) will suffice to compensate it?—W. R. K. Imprimis, I congratulate you on your observation of the reappearance of Aldebaran from occultation on Sunday week. It was more than any one saw in this part of the world. In the next place, I rather fail to understand your figures. Dublin is 25m. 22s. *west* of Greenwich. Consequently, 7h. 37m. Dublin time is 8h. 2m. 22s. Greenwich time: because the earth is turning on her axis from west to east, and Greenwich gets under any celestial body, or has that body (say the sun), on its meridian 25m. before Dublin does. Hence, if you saw Aldebaran reappear from behind the moon's limb at 5h. 27m. Dublin time, it must have been 5h. 55m. 22s. at Greenwich at that instant. Your difficulty about the discrepancy between these corrected times of your observations, and those predicted by "F.R.A.S." in his "Face of the Sky," admits of a very easy solution. The times he gives are those at which the phenomena will happen at Greenwich. But Dublin is 2° north of Greenwich, which, in itself, must apparently *depress* a body so close to the earth as the moon is, in the sky; moreover, it is 6° 20′ to the west of the prime meridian, which will seemingly shift the moon towards the *East*. From these considerations you will see that the occultation of stars will take place at different times, and at different parts of the moon's limb in Dublin to what they will at Greenwich; nay, it may happen that a star will be occulted at Greenwich, of which the moon will pass quite clear in Dublin—and *vice versâ*.—F. C. Go into any assembly of men famous in literature, science, or art, and you will all but invariably find that the most distinguished among them are *little* men. Your strapping handsome fellow six feet high takes his share in muscle to the loss of brain power. With reference to the other part of your letter, it almost seems to me as though *Medical* advice was requisite.—THOS. AGNEW & SONS. I was unfortunately unable to avail myself of it.—H. B. L. Read the masterly critique on "The Unseen Universe" in Vol. I. of the "Lectures and Essays," by the late Prof. Clifford, published by Macmillan & Co.—HARDWARE. They can be placed in 120 different ways.—JOHN HAMPDEN. You *will* have your little joke.—T. W. BACKHOUSE. I gravely question your view of the action of the light of a star (just at the instant of its disappearance as a point) on the retina. I further fail to share in your wonder that streaks and wisps of milky light attached, as it were, to the galaxy are not included in lists of isolated nebulæ. I cannot say, off-hand, how the author of the paper arrived at the figures you quote.—W. M. Get "Experimental Physiology: its Benefits to Mankind," by Sir Richard Owen, published by Longmans & Co., two or three years ago, and look through back volumes of the *Medical Press and Circular*.—TANNAKER BUHICROSAN. See KNOWLEDGE for Feb. 6, p. 110.—H. R. D. M. So far from having been "bored," I have read your long letter through with a considerable amount of interest, and thank you sincerely for the courteous and friendly spirit which pervades it. Let me deal with the chief points upon which you touch seriatim. To begin with the velocity of light. The way in which the 192,000 miles per second was arrived at was by the observation of the apparent retardation of the phenomena of Jupiter's satellites, as observed from opposite extremities of a diameter of the earth's orbit. The amount of its retardation was, as I have said, simply a matter of observation, and knowing accurately the diameter of our orbit in miles, a very simple sum would suffice to show the velocity of light in miles per second. By combining the results of the transits of Venus of 1761 and 1769, Encke, just fifty years ago, calculated the solar parallax at 8·571″, which would place the earth at a mean distance of 95,370,000 miles from the sun. But in 1854 Hansen threw grave doubts upon the accuracy of Encke's determination, by proving that the motions of the moon demanded a reduction of something like $\frac{1}{30}$th of the whole amount of this parallax; and the recent more accurate observations of the transits of Venus, the parallax of Mars, &c., all combine to show that the solar parallax does not differ much from 8·82″, which would, in turn, reduce the diameter of the earth's orbit and the velocity of light. Meanwhile, Fizeau, Foucault, Cornu, Young, Forbes, and Michelsen had, by the aid of most ingenious apparatus, been measuring the actual rate at which light travels on the earth's surface, and, as the final and most trustworthy result, Glazebrook, in his "Physical Optics," gives 186,771 miles per second as that rate; a quantity in the most perfect agreement with the increased parallax of the sun. Of course, the linear (not proportional) dimensions and masses of the whole solar system (save those of the earth) have had to be reduced, as you will see if you will compare a table of them given in every book on astronomy thirty years old, with the corresponding one in a similar work published recently. Your account of the destruction of the pre-historic mounds in your neighbourhood is at once interesting and painful. The utter disregard of many of our most precious archæological relics is simply a scandal to us as a nation. I fear that the mere inspection of your primitive "Macadam," would scarcely enable anyone to form a definite opinion as to whether it had been employed for purposes of smelting or of cremation. On the subject of glacial epochs in these islands and their existing traces, read Ramsay's excellent book, "The Physical Geology and Geography of Great Britain," published by Stanford. Coal-fields, by the bye, afford evidence of "a moist and equable climate," by no means of a tropical, or even sub-tropical one. I quite join with you in the denunciation of the American vulgarism "at" for "in." The distinction that used to be made may be illustrated by saying that formerly it would have been written that a man was stopping *at* Capel Curig, but that he lived *in* London.—JOHN HARRIS. Received; but it is not a matter suitable for discussion in these columns.

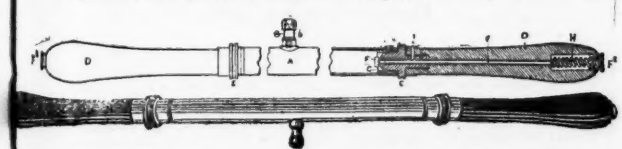
Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals*

THE AMMONIAPHONE.

[Patents Nos. 1,463 and 10,500. 1884.]—The accompanying diagrams illustrate one of the most remarkable inventions of the age. It is the outcome of twenty-nine years of hard labour in pursuit of a definite object. Dr. Carter Moffat says that when but a boy he was struck with the rather curious idea that the beauty of Italian vocal tone was due to something in the air of Italy, and that Italy as a resort for invalids was due to the same cause. He began at that early age to make chemical experiments, to prepare endless varieties of gases, solid substances, and fluid bodies—to inhale and to partake of these materials in the hope that his voice might become benefited, and made strong and musical. It was his passion to improve the singing and the speaking voice, and he still felt that the beauty and mellowness of the Italian tone was to be attributed to its atmospheric peculiarities. For more than six years he attended the post-mortem rooms of the Glasgow Royal Infirmary, and made over thirty-five analyses of the miliary tubercles in the lungs of persons who had died from consumption.

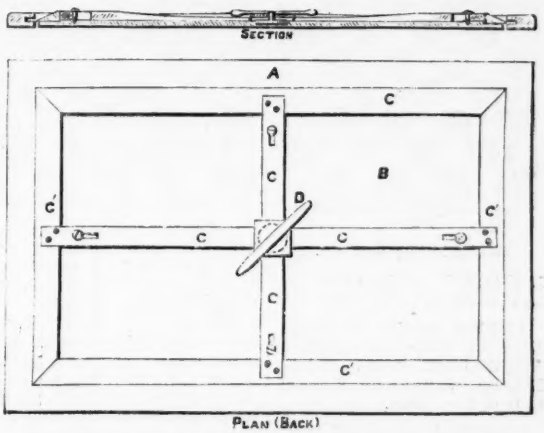
A little over ten years ago, Dr. Carter Moffat had occasion to visit Southern Italy, and he relates that no sooner had he reached the shores of the Adriatic, than he perceived the peculiar tint of the vegetation to be quite different from what it is in our own country. His chemical knowledge at once informed him that the yellow-green tint of the grass, the vine, the olive, the cabbage even, was due to a bleaching action—to something in the air—whence he proceeded to analyse the air and dew of the neighbourhood. He says: "Reverentially did I kneel and withdraw that sparkling globule into a glass tube, and with anxious mind I applied a few delicate chemical tests. Roaming from plain to plain and valley to valley, I made over seventy-three analyses of the air and dew. I went to the valley in which the celebrated sympathetic tenor Guiglini was said to have been brought up, and in that peaceful spot I found the atmosphere almost saturated with peroxide of hydrogen and free ammonia. I noted the maximum proportion of hydrogen peroxide to be present in the air about from eleven to two in daytime, dwindling down to a mere trace at dusk, and developing with the sunlight. The free ammonia appeared to be present in always about the same amount, no matter what hour of the day." These and subsequent experiments proving successful, he devoted himself to the perfection of the ammoniaphone, a task which engrossed his attention for nine years. The instrument which forms the subject of the later patent (taken out by Mr. C. B. Harness) consists of a metallic tube, containing a piece of rope saturated with ammonia, peroxide of hydrogen, and a few flavouring compounds, and provided with a mouthpiece midway between its



ends. A ferrule or ring, having an internal screw-thread, is soldered, or otherwise fixed, in each end of the tube A. D D are handles, each provided with an externally screw-threaded piece E, which fits into one of the rings or ferrules C, so that the handles may be screwed or unscrewed at will. Through each of the handles is passed a rod F^1, one end of which extends through the piece E, and carries a plate or disc F, provided on its inner face with a washer of leather, india-rubber, or other suitable material, so as to form a valve capable of closing the orifice or passage in the piece E. A spiral spring H is placed upon each of the rods F, so that it bears at one end upon the end of a recess or cavity in the handle, and at the other end upon a cap or push-piece F^2 fixed on the outer end of the rod. This spring tends to press the washer G against the end of the piece E, and thus close the orifice or passage, thereby preventing the admission of air to the tube. A small aperture I is formed in each of the handles D for the admission of air to the tube A when the valve is opened. The mouthpiece B has a perforated screw-cap. The person desiring to use the apparatus grasps the handles D, and applies his mouth to the mouthpiece B, then, by pressing push-pieces F^2, he opens the orifices for the admission of air to the tube A; he can then conveniently inhale the vapour of the substance contained in the tube. The instruments are made of various strengths, the strongest lasting for twelve months, when the saturated rope requires to be renewed. Weaker forms are more generally employed, which, when called into use four times a day, last for about two and a half months. We cannot but bear testimony to the remarkable qualities possessed by the instrument. Prior to determining to notice it, we examined it. One draught of air was inhaled, when, to our great astonishment, the intensity of the voice was about doubled, while its clearness was almost as greatly increased. The Ammoniaphone is gaining many patrons, and it deserves them, for we are convinced that it is no exaggeration to say that "the employment of the Ammoniaphone according to directions Italianises the voice, and makes a weak voice, or a drawing-room voice, strong, rich, clear, and ringing."

PAPER-STRETCHER.

[Patent No. 6,407. 1884.]—The object of this invention, patented by Mr. C. Atkinson, is to stretch drawing-paper or other similar material without resorting to the usual process of first damping the paper, the paper being at once tightened and held firmly in its place by mechanical means, no drawing-pins, glue, or other adhesive material being required. The invention consists of a frame A in combination with the drawing-board B, which can be removed from the frame when required. C and C′ are pieces of wood fastened



PLAN (BACK)

together at right angles, and slide upon the back of the board, and are actuated by a spiral screw fixed at the centre. The edges of the pieces C′ fit into the grooves in the frame. The handle D is for turning the screw. In using the improved drawing-board the board B is first removed from the frame A. The sheet of paper to be stretched is then laid over the frame A, the board B being pressed upon the surface of the paper until the edges of the pieces C′ are opposite the grooves in the frame. The screw is then turned, which action has the effect of forcing the edges of the paper into the grooves in such a manner as to effectually tighten and stretch the paper, and hold it firmly in its place.

STEAM WASHER.

[Patent, No. 2,595. 1884.]—The principal novelty of this improved Steam Washer (patented by Mr. John Howarth, of Burnley), over others, consists in the employment of a number of pegs or projections, which constantly change and present fresh surfaces of clothes to the combined action of the boiling water and steam, and also in an arrangement of buckets or troughs which raises and constantly throws boiling water upon the clothes, thereby helping in the removal of particles of dirt. It is claimed that the most delicate fabrics may be washed in this Washer with perfect safety, and that the clothes being constantly shifted, the steam thoroughly penetrates them, and whilst removing dirt, also destroys disease germs. The water is kept boiling and steam generated in the cylinder of the Washer by means of a gas-burner.

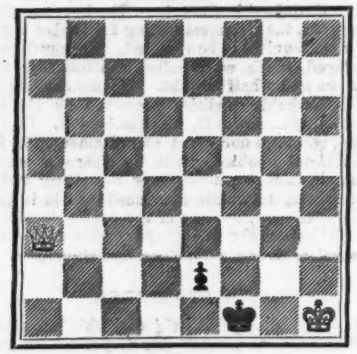
XUM

Our Chess Column.

By Mephisto.

USEFUL END GAMES.

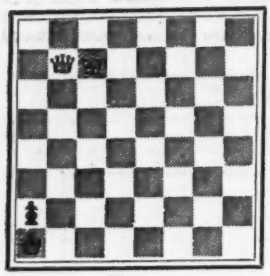
Black.



White.

White to play and mate in five moves.

Black.



White.

White to play and win.

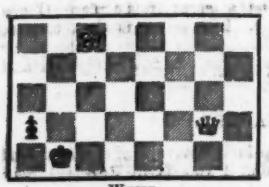
1. K to Kt6 K to Kt7
2. K to B5 (ch) K to B8

If Black persists in playing K to R8, White plays 3. K to Kt4, K to Kt7. 4. K to B4 (ch), K to R8. 5. K to Kt6, K to Kt8. 6. Q to R sq. mate.

Or, if Black plays 2. K to B7, 3. Q to KKt2 (ch), as move 4 in the following variation:—

3. Q to R sq. (ch) K to Kt7
4. Q to Kt2 (ch) K to Kt8

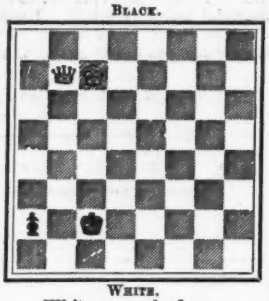
If K to Kt6, 5. Q to Kt7 wins.



White.

5. K to B4! P to R8 (Q)
6. K to Kt3 and White must win.

Black.



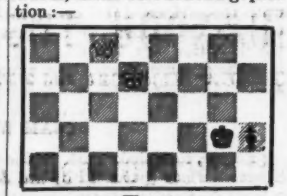
White.

White can only draw.

1. Q to B6 (ch) K to Kt7
2. Q to Kt5 (ch) K to B7
3. Q to R4 (ch) K to Kt7
4. Q to Kt4 (ch) K to B7
5. Q to R3 K to Kt8
6. Q to Kt3 (ch) K to R8

and the game is drawn, as, on account of Black being either stalemated or advancing his P, White cannot do anything but give check with the Queen.

As will be seen in the annexed position, White avoids the threatened stalemate position against a R's P if the K is sufficiently near, no matter where, as in the following position:—



White.

1. Q to B2 (ch) K to Kt8
2. K to K3 K to R8
3. K to B3 and wins.

The New Orleans Chess, Checkers, and Whist Club have issued a circular inviting subscriptions towards a Tournament to be held at New Orleans. The Club heads the subscription-list with $500. Southern people generally do things impulsively; we are, however, quite taken aback by the dates given in the circular, which was issued on or about February 10, with the proviso that on March 25 the committee will again consider the matter; but, notwithstanding this, the date for commencement of the Tournament is fixed for April 7. We hope the project of the New Orleans Club will meet with success. The *Chess Players' Chronicle* contains a series of reprints of the American "Supplement to the Synopsis." No doubt chess-players will welcome the appearance of these articles in this useful publication.

SOLUTION.

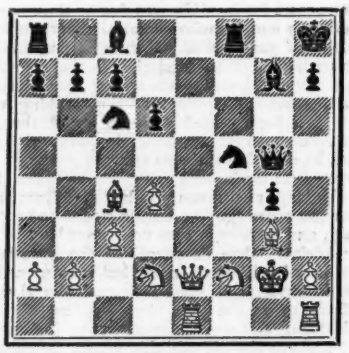
Problem No. 148, by E. Carter, p. 162.

1. Kt to B6	K × Kt, or	1.	K to B6
2. B to B5	K × Kt	2. P to Kt4!	K to Q5
3. B to Q4 (ch)	Mate	3. B to Kt2 (ch)	Mate
2. if	K to B5		
3. B to Q6 (ch)	Mate		

Solution of Problem No. 149 received from W., J. H. Hodd, Ravenhoe, and Donna.

END GAME FROM ACTUAL PLAY.

Black.



White.

Black proceeded with—

	P to Kt4
B to Kt3	Q Kt × P!
P × Kt	Kt × P
Q to K3	Q to R4
KR to B sq.	B to Kt2 (ch)
K to Kt sq.	QR to K sq.
Q to Q3	R to B6!
Q to Kt sq.	R to K7!

A very fine move, and part of an elegant combination. If White plays R × R, then Kt × R (ch), K to R sq., R × Kt (ch), and mate soon follows.

Q to Q sq.	R × B (ch)!
P × R	Q to R8 (ch)!
Kt × Q	R to Kt7 mate

The conception of the position, beginning with P to Kt4, is of the highest order.

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NOTICES.

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